OVERVIEW OF THE FEDERAL R&D BUDGET FOR FISCAL YEAR 2004

HEARING

BEFORE THE

COMMITTEE ON SCIENCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED EIGHTH CONGRESS

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February 13, 2003

OVERVIEW OF THE FEDERAL R&D BUDGET FOR FISCAL YEAR 2004

THURSDAY, FEBRUARY 13, 2003

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE,
Washington, DC.

The Committee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Sherwood L. Boehlert (Chairman of the Committee) presiding.

HEARING CHARTER

COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

Overview of the Federal R&D Budget for Fiscal Year 2004

THURSDAY, FEBRUARY 13, 2003
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

On Thursday, February 13, 2003, the House Science Committee will hold a hearing to consider President Bush's fiscal year 2004 budget request for research and development. Four Administration witnesses will review the proposed budget in the context of the President's overall priorities in science and technology. The Science Committee will hold a separate hearing on February 27 on the budget request for the National Aeronautics and Space Administration. The Subcommittee on Environment, Technology and Standards will hold a hearing later this year on the budget request for research and development at the Environmental Protection Agency.

2. Witnesses

The Committee will hear testimony from the following four witnesses:

Dr. John Marburger is the Director of the Office of Science and Technology Policy (OSTP), the White House science office. Prior to joining OSTP, Dr. Marburger served as President of the State University of New York at Stony Brook and as Director of the Brookhaven National Laboratory.

Dr. Samuel W. Bodman is the Deputy Secretary of the Department of Commerce. Prior to joining the department, Dr. Bodman—an engineer by training—has served as Chairman and CEO of Cabot Corporation, President and CEO of Fidelity Investments, and as an Associate Professor of Chemical Engineering at Massachusetts Institute of Technology.

Dr. Rita R. Colwell is the Director of the National Science Foundation (NSF). Before joining the Foundation, Dr. Colwell served as President of the University of Maryland Biotechnology Institute and Professor of Microbiology at the University Maryland. She was also a member of the National Science Board from 1984 to 1990.

Mr. Robert Card is the Under Secretary of Energy for Energy, Science and Environment. Prior to joining the Department of Energy (DOE), Mr. Card served as President and CEO of Kaiser-Hill Company, LLC, where oversaw the cleanup and closure of the Rocky Flats nuclear production facility. Before that, he served as Director and Senior Vice President of CH2M Hill Companies, Ltd., an international engineering consulting group.

3. Background

On February 3, 2003, President Bush delivered his Fiscal Year 2004 (FY04) Federal Budget submission to Congress, proposing $2.2 trillion in outlays, an estimated 19.7 percent of gross domestic product, and $1.9 trillion in receipts. The research and development budget (R&D) budget proposes significant increases for development related to defense and homeland security, but only modest or no increases in the major research accounts.

Other than Defense and Military Construction, Congress has not passed appropriations bills for FY03, making meaningful year-to-year budget comparisons difficult. In the case of the National Science Foundation (NSF), the FY04 request represents a nine percent increase over the FY03 request, but the FY03 appropriations are likely to be significantly higher than the FY03 request (the FY04 request represents only a 1.1 percent increase over the House appropriations mark, for example). At $5.5 billion, the FY04 request for NSF falls well short of the $6.4 billion authorized by Congress last year.

Despite the confusing lack of a proper baseline, one trend is clearly discernible in the R&D proposal: the budget request includes significant increases for security and defense development, particularly for missile defense and tactical air systems

development in the Department of Defense (DOD), but the request decreases basic and applied research associated with those programs. The new Department of Homeland Security (DHS) is set to become a major new research funding agency with a requested FY04 R&D budget of nearly $1 billion—a 32 percent increase over the FY03 R&D request for those programs that are transferred to DHS. The new R&D money at DHS will be focused on development activities related to protection against chemical, biological, and nuclear threats. Basic research associated with those programs is not increased. Moreover, basic and applied research at DOD (6.1, 6.2, and 6.3 accounts) is reduced from the levels enacted last year.

The Federal Science and Technology (FS&T) budget—a subcategory of R&D spending that emphasizes basic and applied research—remains essentially flat. Support for research in the physical sciences, long an area of concern for the Science Committee, is increased at the National Science Foundation (NSF), but the request for the Department of Energy's (DOE) Office of Science, the single largest civilian source of research support for physical science, is flat for the third year in a row.

The following highlights flag those areas of greatest interest to the Science Committee:

Defense and Security R&D: development activities in both DOD and DHS are up sharply from last year's request, but basic and applied defense and security research are decreased relative to the FY03 request.

Balance of the Research Portfolio: growth in the National Institutes of Health (NIH) research budget slows to two percent in the President's budget after five consecutive years of double digit increases. Nonetheless, at $27.9 billion, the request for NIH is larger than the request for all other civilian science and technology research.

Physical Science Research: while physical science at NSF receives increases this year, the budget request for DOE's Office of Science, which funds more physical science research than any other civilian agency, is flat for the third year in a row.

The National Science Foundation (NSF): the budget requests $5.48 billion for NSF in FY04, an increase of $453 million (nine percent) over the FY03 request. This is, however, just one percent and four percent, respectively, above the currently pending House and Senate appropriations bills, and falls far short of the $6.4 billion authorized by Congress last year for FY04.

The Advanced Technology Program (ATP): the President's budget effectively eliminates ATP, providing only enough money to close out the program.

The Manufacturing Extension Partnership (MEP): the request reduces the MEP budget by 78 percent over what was enacted in FY02 and ends support for all MEP state centers with the exception of two centers that are fewer than six years old.

The National Sea Grant Program: last year, the Administration proposed to transfer Sea Grant to the National Science Foundation and zeroed out the Sea Grant budget line in the FY03 request for the National Oceanic and Atmospheric Administration (NOAA). In response, the Science Committee led a successful effort to reauthorize and strengthen the program. The Administration has determined that the Committee's enacted reforms address their concerns and has requested $57.4 million for the National Sea Grant Program at NOAA.

The President's Management Agenda: for the FY04 budget request, the Administration has expanded its effort to better link agency performance with budget decision-making through use of the Program Assessment Rating Tool (PART). The relationship between the PART ratings and the budget request is unclear, however. For example, the Manufacturing Extension Partnership (MEP) at the National Institute of Standards and Technology (NIST) was rated as "moderately effective," but the program is all but eliminated in the FY04 request.

Climate Change Research: the budget requests $182 million for the interagency Climate Change Research Initiative (CCRI), up from the $40 million requested for FY03, but much of the $142 million increase appears to represent reclassification of ongoing research. CCRI is intended to target critical scientific uncertainties and deliver results in 3–5 years. A draft strategic plan for the initiative was released late last year. It is not clear from the budget submission, however, to what extent CCRI efforts will be guided by the strategic plan.

Climate Change Technology Development: the DOE FY04 budget requests $1.6 billion for climate change technology research and development, an increase of five percent from FY02 enacted level. The increase reflects an increase in carbon seques-

tration research related to utility sector emissions and an accounting change that now treats ongoing nuclear spending in the climate totals. As in FY03, the budget also requests $40 million for a competitive solicitation for the National Climate Change Technology Initiative. However, DOE has not yet produced the government-wide climate change spending review promised by the department last year or developed a comprehensive plan (or process for developing a plan) to guide this spending.

A. Interagency Research Activities

National Nanotechnology Initiative (NNI): NNI, which involves 10 federal agencies continues to be a high priority for the Administration. The budget requests $849 million for NNI in FY04, an increase of $75 million, or 9.7 percent, over the FY03 request.

Networking and Information Technology R&D Initiative (NITRD): NITRD also remains a high priority for the Administration. The budget requests $2.2 billion for NITRD in FY04, a six percent increase over the FY03 request.

U.S. Global Change Research Program (USGCRP): climate change research is level funded in the President's request at $1.75 billion. A significant effort is underway, led by the National Oceanic and Atmospheric Administration (NOAA), to rationalize and reprioritize research in this area. While USGCRP is flat funded for FY04, the Committee expects that some reallocation will occur within this program.

Homeland Security: the budget requests an estimated $3.2 billion across all agencies for homeland security R&D in FY 2004, including $1 billion for R&D in the new Department of Homeland Security (DHS). Focused primarily on development, the DHS R&D request represents an estimated 32 percent increase over the FY03 R&D activities transferred into the department.

The National Earthquake Hazards Reduction Program (NEHRP): NEHRP is a multi-agency program funded by the Federal Emergency Management Agency (FEMA), NSF, the U.S. Geological Survey (USGS), and the National Institute of Standards and Technology (NIST). The President's overall FY04 request for NEHRP is not clearly discernible in the budget submission, but $45, $46, and $2.5 million is requested, respectively, for NSF, USGS, and NIST. These amounts are roughly flat compared to the FY02 enacted level.

Budget charts for NNI, NITRD, and USGCRP are given in section 5 at the end of this charter.

B. National Science Foundation (NSF)

The National Science Foundation is the primary source of federal funding for non-medical basic research conducted at colleges and universities and serves as a catalyst for mathematics, science, engineering and technology education reform at all levels. The Foundation continues to receive high marks under the President's Management Reform Agenda. This year the Foundation received the only two "green lights" from the Office of Management and Budget (OMB)—one for financial management and the other for e-government.

NSF's FY04 budget request is $5.48 billion, an increase of 9.0 percent, or $453 million over the FY03 request. After adjusting for last year's unsuccessful proposal to transfer several programs from other agencies into NSF, the agency's proposed increase is actually 10.6 percent.[1] This is, however, just one percent and four percent above the levels provided in the currently pending House and Senate FY '03 appropriations bills, respectively.

Issues/Questions Raised by the FY04 Request for NSF

Budget Baseline: P.L. 107–368, the National Science Foundation Authorization of 2002 authorized the doubling of NSF over five years. In keeping with this legislation, the President has proposed significant increases for NSF over the FY03 budget request. Will the Administration support a significant increase for the Foundation above the final FY03 appropriated amount when that becomes the baseline?

Major Research Equipment and Facilities: the FY04 budget document provides detailed information regarding the projected life cycle costs of major research user facilities and for the first time provides a priority list for new starts. The budget

[1] The President's FY03 NSF budget request included $76 million in programs proposed to be transferred from other agencies. None of these transfers were approved by the Congress and the Administration has not included them within the FY04 budget request.

does not, however, describe the criteria used to establish these priorities as required by P.L. 107–368.

Cyber security: cyber security research increases by 133 percent from $15 million to $35 million. This amount, however, is significantly lower than the $105 million authorized by Congress for FY04 in P.L. 107–305, the Cyber Security Research and Development Act.

Education and Human Resources: funding for NSF"s education programs increases by 3.3 percent over the FY03 budget request. The Math and Science Partnership program is funded at $200 million. The Noyce Scholarship Program and the Tech Talent programs are funded at $4 million and $7 million, respectively.

Homeland Defense: the NSF budget includes programs on addressing security needs for information technology systems ($35 million), on understanding the ecology and spread of infectious diseases ($10 million), on sequencing the genomes of microorganisms ($15 million), including potentially harmful microbes (such as anthrax), on information security and assurance workforce development ($16 million), on data mining, and on sensors and sensor networks.

Program Assessment Rating Tool (PART): for the FY04 budget request, the Administration has expanded its effort to better link agency performance with budget decision-making through use of the Program Assessment Rating Tool (PART). Two NSF programs were selected for PART evaluations in this budget: the Geosciences Directorate, and the "Tools" aspect of the NSF budget.

The Geosciences Directorate received a rating of "Moderately Effective." The assessment indicated that, while the purpose of the program is very clear, NSF"s goals are too broad to be useful in monitoring the effectiveness of the directorate. The assessment also noted that it is particularly difficult to establish annual performance measures for basic research and that, since primary budget decisions are not made at the directorate level, the administration will likely not use directorates as a category for future PART assessments.

The NSF Tools component of the budget—the portion of the NSF budget that funds research equipment and infrastructure—received a rating of "Effective." The assessment found that the program uses an efficient peer review award process and regularly conducts independent program evaluations to support further program improvements. The assessment did note, however, that NSF"s priority setting process for large facilities is not readily transparent, and that the budget will provide a rank ordering of all large facility construction projects as well as information on how the projects were selected, approved, and prioritized.

National Science Foundation FY2004 Budget Request
(Budget Authority in Millions)

							FY04 Request, Percentage Change from...				
Account	FY02 Actual	FY03 Request	FY03 House	FY03 Omnibus*	P.L. 107-368 Authorized Level	FY04 Request	FY03 Request**	FY02 Actual	FY03 House Approp.	FY03 Omnibus Approp.	FY04 Authorized Level
RRA	3616.0	3783.2	4150.0	4081.7	4799.8	4106.4	8.5%	13.6%	-1.1%	0.6%	-14.4%
BIO	509.6	525.6	584.7	535.0	--	562.2	7.0%	10.3%	-3.8%	5.1%	--
CISE	515.0	526.9	592.1	604.0	--	584.3	10.9%	13.4%	-1.3%	-3.3%	--
ENG	470.8	488.0	543.2	556.4	--	536.6	10.0%	14.0%	-1.2%	-3.6%	--
GEO	609.6	691.1	700.9	680.0	--	687.9	-0.5%	12.9%	-1.9%	1.2%	--
MPS	920.4	941.6	1058.5	1056.6	--	1061.3	12.7%	15.3%	0.3%	0.4%	--
SBE	184.0	195.6	195.6	190.0	--	211.7	8.2%	15.1%	8.2%	11.4%	--
OPP	300.8	303.8	254.0	314.1	--	329.9	8.6%	9.7%	29.9%	5.0%	--
IA	105.8	110.6	221.1	145.6	--	132.5	19.7%	25.2%	-40.1%	-9.0%	--
EHR	866.1	908.1	910.6	932.7	1157.2	938.0	3.3%	8.3%	3.0%	0.6%	-18.9%
MRE	115.4	126.3	159.5	59.3	211.2	202.3	60.2%	75.4%	26.8%	241.3%	-4.2%
S&E	169.9	203.0	193.9	182.2	210.3	225.7	11.2%	32.8%	16.4%	23.9%	7.3%
OIG	6.7	7.7	9.0	9.1	8.5	8.8	13.9%	30.9%	-2.6%	-3.2%	3.5%
NSB	--	--	--	3.5	3.9	--	--	--	--	--	--
Total	**4774.06**	**5028.22**	**5422.9**	**5268.98**	**6390.83**	**5481.2**	**9.01%**	**14.8%**	**1.1%**	**4.0%**	**-14.2%**

* The FY03 Omnibus levels do not reflect a final 1.3% across the board reduction that was approved by the Senate but not applied to specific agencies and programs. They do, however, reflect the application of an earlier 1.6% across the board reduction.

** The total NSF percentage change of nine percent does not account for $74 million in FY03 proposed transfers to the Geosciences Directorate that did not occur. After subtracting these funds from the '03 request level, the actual proposed increase for NSF is 10.6%. Accordingly, the Geosciences increase is then 11.5%, not a -0.5% decrease.

Acronyms:

RRA	Research and Related Activities	BIO	Biological Sciences
EHR	Education and Human Resources	CISE	Computer & Information Science & Engineering
MRE	Major Research Equipment	ENG	Engineering
S&E	Salaries & Expenses	GEO	Geosciences
OIG	Office of Inspector General	MPS	Mathematical and Physical Sciences
NSB	National Science Board	SBE	Social, Behavioral, and Economic Sciences
		OPP	Office of Polar Programs
		IA	Integrative Activities

C. Department of Homeland Security (DHS)

The budget requests $1 billion[2] for R&D in DHS, a 32 percent increase over the FY03 request, and significantly greater than the $266 million appropriated for these activities in FY02. The primary focus of the DHS effort will be on development ($663 million, or 66 percent), while the amount requested for basic research, $47 million, is unchanged from the FY03 request.

The budget requests $803 million for the activities carried out by the Under Secretary for Science and Technology (S&T), an increase of $242 million (43 percent) over the FY03 request for these activities. Also, within the S&T Under Secretariat, the Homeland Security Advanced Research Projects Agency (HSARPA) will direct $350 million in new funding toward engaging the private sector and others in the development of innovative, high-payoff capabilities in high-priority operational areas, like protecting critical infrastructure and securing our borders. These funds would be divided among the activities described in the budget chart that follows, but the specific breakdown remains unclear.

A base for the activities of the S&T Under Secretariat will be formed by a transfer of programs from the Department of Energy, scheduled to occur March 1, 2003. The $83 million of programs being transferred include R&D work on countering chemical, biological, nuclear, and radiological threats, nuclear smuggling detection activi-

[2] The $1001 million for DHS R&D includes some (less than $100 million) non-counterterrorism R&D from existing programs in agencies (like the Coast Guard) that are being transferred into DHS.

ties, nuclear assessment programs, and the environmental measurements laboratory. Methods for coordinating the DHS S&T programs with programs that remain at DOE and with programs at other R&D agencies (especially NIH) remain to be defined.

The budget requests an estimated $200 million for R&D in DHS outside of the S&T Under Secretariat. For example, $65 million is requested for the Transportation Security Administration for R&D directed toward developing better screening technology and threat detection methods for protection of aircraft and passengers.

Science and Technology Programs at DHS	FY 2004 Request (in millions)
Radiological/Nuclear Countermeasures	137
Biological Countermeasures[3]	365
Chemical/High Explosives Countermeasures	65
Threat & Vulnerability Testing and Assessments	90
Standards Program[4]	25
Conventional Missions Program (supporting RDT&E)[5]	55
University Programs, Emerging Threats and Rapid Prototyping Program[6]	62
Unidentified Programs	4
Total:	**803**

[3] Biological Countermeasures will be done in partnership with HHS, Agriculture, and others.
[4] Standards Program will be done in partnerships with NIST, ANSI, and others.
[5] Conventional Missions Program will support RDT&E and Systems Development for Coast Guard, Secret Service, Borders and Transportation Security Directorate, and Emergency Preparedness and Response Directorate.
[6] University Programs, Emerging Threats and Rapid Prototyping Program includes establishing the Homeland Security Institute.

Other Agencies

Approximately $2.3 billion is proposed for R&D programs for combating terrorism in departments and agencies outside of DHS. The bulk of this funding, $1.6 billion, is for biodefense programs at NIH. The remaining funds would support ongoing efforts in nuclear/radiological materials detection, cyber security, aviation security, workforce development, and other areas that are spread throughout the government.

Issues/Questions Raised by the FY04 Request for DHS

Homeland Security Advanced Research Projects Agency (HSARPA): the roughly $800 million requested for science and technology at DHS includes $350 million for HSARPA, a homeland security technology development agency created by the Act that established the department and modeled on the Defense Advanced Research Projects Agency (DARPA). The budget documents do not indicate, however, how HSARPA will contribute to the programs listed in the budget chart above and how the balance will be struck between the internal and external research programs of the S&T Under Secretariat.

Cyber security R&D: through hearings and legislation, the Science Committee has identified cyber security R&D as a high-level domestic security concern, yet nowhere in budget request for DHS is cyber security R&D explicitly discussed.

D. National Institute of Standards and Technology (NIST)

NIST's Laboratory Programs

The budget requests $388 million for NIST's laboratories in FY04. This request would fund a wide range of research conducted at NIST's laboratories in Gaithersburg, Maryland and Boulder, Colorado. The request represents a slight decrease relative to the FY03 request, but the FY03 request contained a one-time $35 million increase for specialized equipment. The FY04 request is approximately $30 million higher than the average of the pending FY03 House and Senate appropriations

marks, and it is $58 million more than the FY02 enacted level. Accordingly, several of the NIST laboratories would increase in both staff and funding should this budget be enacted.

Construction

The Administration has requested a significant increase to fund construction at NIST facilities, most of which would go toward reconstructing the aging facilities in Boulder, Colorado. As part of the Committee's oversight activities last year, Congressman Ehlers led a Congressional delegation to review these facilities and found that they were badly in need of renovation and repair.

Advanced Technology Program (ATP) and Manufacturing Extension Partnership (MEP)

Both ATP and MEP are largely extramural (outside of the laboratories) grant programs (ATP provides nearly $15 million for intramural research at NIST labs) administered by NIST. The goal of ATP is to provide grants in order to "bridge the gap between the research laboratory and the marketplace" through partnerships with the private sector. ATP seeks to develop pre-competitive, emerging, and high-risk technologies that promise significant commercial payoffs and widespread benefits for the Nation. MEP funds state and regional centers that help small U.S. manufacturers adopt advanced manufacturing technologies, techniques, and business best practices.

The President's budget proposes to effectively eliminate the Advanced Technology Program (ATP) at NIST, providing $27 million to cover closeout costs compared with $184.5 million enacted in FY02. Likewise, the request ends support for all Manufacturing Extension Partnership (MEP) state centers with the exception of two that are less than six years old—the Indiana Business Modernization and Technology Corporation and TECHSolve, in Southwest Ohio. The $12.6 million request will maintain staff in Gaithersburg to serve in a consulting role for the state centers. The Administration's justification for this reduction is that when Congress created the MEP program it originally intended that the centers would be self-supporting. In 1994, however, Congress amended the original MEP statute to allow for ongoing support of state centers, not to exceed one-third of a center's total funding.

While there is a long history of controversy surrounding NIST's technology programs, the Administration has indicated that both programs perform and are managed well. It justified cutting these programs on the basis that higher-priority programs required funding, and the need for these programs wasn't clear given private sector activity in these areas.

Issues/Questions Raised by the FY04 Request for NIST

Advanced Technology Program (ATP): the budget request effectively eliminates ATP, but this program supports approximately $15 million of research at the NIST laboratories. If Congress accedes to the President's request, how will the laboratory research funds from ATP be replaced?

Manufacturing Extension Partnership (MEP): MEP received a "moderately effective" rating in the Program Assessment Rating Tool (PART) process, yet the budget request eliminates funding for all but two state MEP centers. How was the PART rating used in determining the request level for MEP?

National Institute of Standards and Technology (NIST) FY2004 Budget Request
(Budget Authority in Millions)

Account	FY02 Actual	FY03 Request	FY03 House	FY03 Omnibus*	FY04 Request	FY04 Request, Percentage Change from... FY03 Request**	FY02 Actual	FY03 House Approp.	FY03 Omnibus Approp.
TA	8.2	7.9	7.9	7.8	8	1.3%	-2.4%	1.3%	2.6%
NIST Labs	330	389.2	351.2	357.6	387.6	-0.4%	17.5%	10.4%	8.4%
ITS									
ATP	184.5	107.6	0	182.4	27	-74.9%	-85.4%	--	-85.2%
MEP	106.5	12	110	104.9	12.6	5.0%	-88.2%	-88.5%	-88.0%
Construction	63.6	54.2	54.2	64.4	69.6	28.4%	9.4%	28.4%	8.1%
Total	**692.8**	**570.9**	**469.1**	**717.1**	**504.8**	**-11.58%**	**-27.1%**	**7.6%**	**-29.6%**

* The FY03 Omnibus levels do not reflect a final 1.3% across the board reduction that was approved by the Senate but not applied to specific agencies and programs. They do, however, reflect the application of an earlier 1.6% across the board reduction.

TA=Technology Administration
ITS=Industrial and Technical Services Account
ATP=Advanced Technology Program
MEP=Manufacturing Extension Partnership Program

E. National Oceanic and Atmospheric Administration (NOAA)

The FY04 budget requests $3.3 billion for NOAA, an increase of $190 million (6 percent) over the FY03 request. The majority of this increase is allocated to restored funding for the Sea Grant program within NOAA (the FY03 request transferred the program to the National Science Foundation), climate change activities, and for the next generation polar satellite program (NPOESS).

Climate Change

NOAA's FY 04 budget request includes a $17 million increase in climate change research and observations. Most of the increase is to support the President's Climate Change Research Initiative (CCRI), which focuses on priority areas such as ocean observations ($10.3 million), aerosol research ($3 million), and computer modeling ($8.5 million). In addition, NOAA redefined about $7 million from its current climate change budget to be part of the CCRI program for a total of $42 million. NOAA's total climate change research, observations and services spending across its line offices is $296 million.

National Weather Service Improvements

NOAA requests a net increase of $28 million for a total request of $820 million for the National Weather Service. Most of the increase is for construction of a new center for weather and climate prediction ($10.4 million). There is also a $5.5 million request for an All Hazards Warning Network. NOAA will automate the collection and dissemination of civil-emergency messages over NOAA Weather Radio, which currently broadcast emergency weather alerts.

Satellite Data Management

The Committee continues to be concerned with NOAA's ability to fully utilize and manage the data coming from its weather satellites. NOAA is requesting a total of $150 million for these activities, a $4 million increase. These systems are crucial to improving weather forecasting models and climate research. NOAA is also requesting a $40 million increase, for a total of $277 million, for the next generation polar satellite program, which is jointly funded by the Air Force. NOAA recently awarded a $4 billion contract for the program, which is expected to be operational in 2012. The Committee will continue to work with the General Accounting Office (GAO) to ensure the program remains on budget and fulfills the stated requirements.

Issues/Questions Raised by the FY04 Request for NOAA

Satellite Data Management: the budget requests a total of $150 million for satellite data management, a $4 million increase over the FY03 request. Is this level of effort sufficient to assure proper handling and archiving of the enormous data streams that will be generated by new weather satellites?

National Oceanic & Atmospheric Administration FY2004 Budget Request

(Budget Authority in Millions)

						FY04 Request, Percentatge Change From ...			
Account	FY02 Actual	FY03 Request	FY03 House	FY03 Omnibus	FY04 Request	FY03 Request	FY02 Actual	FY03 House Approp.	FY03 Omnibus Approp.
NOS	514	404	n/a	508	411	1.7%	-20.0%	n/a	-19.1%
ORF[1]	416	379		406	391	3.2%	-6.0%		-3.7%
PAC[2]	88	20		102	20	0.0%	-77.3%		-80.4%
Other	10	5		n/a	0	0.0%	-100.0%		--
OAR	384	301	n/a	413	381	26.6%	-0.8%		-7.7%
ORF	356	291		396	367	26.1%	3.1%		-7.3%
PAC	28	10		17	14	40.0%	-50.0%		-17.6%
Other	0	0		0	0	0.0%	0.0%		0.0%
NWS	743	772	n/a	750	820	6.2%	10.4%		9.3%
ORF	672	697		683	721	3.4%	7.3%		5.6%
PAC	72	76		67	99	30.3%	37.5%		47.8%
Other	0	0		0	0	0.0%	0.0%		0.0%
NESDIS	704	759	n/a	747	838	10.4%	19.0%		12.2%
ORF	142	146		134	150	2.7%	5.6%		11.9%
PAC	562	612		607	687	12.3%	22.2%		13.2%
Other	0	0		0	0	0.0%	0.0%		0.0%
Program Support[3]	259	301	n/a	287	433	43.9%	67.2%		50.9%
ORF	181	206		203	333	61.7%	84.0%		64.0%
PAC	62	78		84	10	-87.2%	-83.9%		-88.1%
Other	16	17		n/a	90*	--	--		
NMFS	804	726	n/a	627	732	0.8%	--	--	--
Transfers	($146)	($127)		$18	($289)	--	--		
Total	**3262**	**3136**	**0**	**3350**	**3326**	**6.1%**	**2.0%**		**-0.7%**

*The Programs Account has been modified in the FY'04 Budget to include different budget items

[1] ORF is Operations, Research and Facilities

[2] PAC is procurement, Acquisition and Construction

[3] Includes Fleet and Aircraft Maintenance and NOAA HQ Accounts

[4] National Marine Fisheries Service is budgeted under NOAA, but is under jurisdiction of the Resources Committee

F. Department of Energy (DOE)

The FY04 request for civilian research—$5.4 billion—represents a decrease of 1.2 percent from FY02 enacted levels. The top priorities for energy and science programs include nuclear energy, carbon sequestration, and hydrogen R&D. While funding for the Office of Nuclear Energy is increased, the Office of Science, the Office of Energy Efficiency and Renewable Energy, and the Office of Fossil Energy[7] are essentially flat funded from the FY03 request levels.

The President's hydrogen initiative, announced in the State of the Union speech, is the highest profile of several new initiatives at DOE. The initiative, funded at $272 million in the FY04 request, would expand the focus of the FreedomCAR program from vehicle technology to hydrogen production, storage, and transport. Most of the $272 million appears to be offset by cuts in energy efficiency programs. Overall, the Administration's new hydrogen initiative, including FreedomCAR and the new fuels and infrastructure focus, is projected to require $1.7 billion over the next five years. Of this amount, DOE estimates that $720 million would be new money. A major issue in the hydrogen research effort will be how much the R&D effort should focus on so called "bridge" technologies which rely on using hydrogen from fossil fuels such as coal and natural gas as opposed to long-term efforts to develop cleaner, renewable sources of hydrogen.

The budget requests an increase of 41 percent (to $62 million) for research on carbon sequestration in the utility sector, but funding for biological carbon sequestration ($7 million) and research on the potential environmental impact of utility sector carbon sequestration ($8.5 million) are flat funded in FY04.

[7] The apparent eight percent FE increase from FY03 to FY04 reflects reduced use of previously appropriated clean coal technology funds—actual spending is flat compared to FY03 request and declines ten percent compared to the FY02 enacted funding.

Another recent presidential announcement is the decision to rejoin the International Thermonuclear Experimental Reactor (ITER) project, the international effort to develop a prototype fusion energy reactor at an estimated cost of $5 billion over eight years. While the exact nature of the U.S. participation is subject to negotiation, the FY04 request includes $12 million for ITER, which could rise substantially in future years depending on the level of the U.S. overall commitment and the pace of the effort.

Issues/Questions Raised by the FY04 Request for DOE

Physical Science Research: the budget request for DOE's Office of Science, which funds more physical science research than any other civilian agency, is flat for the third year in a row.

Hydrogen R&D: the budget requests a significant increase for R&D on infrastructure for hydrogen as a fuel for transportation, but these increases appear to be offset by cuts in energy efficiency R&D, the area of research that likely has the most rapid payoff in terms of reducing our dependence on imported energy.

Climate Change Technology: the budget requests $40 million for the President's National Climate Change Technology Initiative, but there are few details on how these funds will be spent.

Department of Energy FY2004 Budget Request for Civilian R&D
(Budget Authority in Millions)

						FY04 Request, Percentage Change from...			
Account	FY02 Actual	FY03 Request*	FY03 House**	FY03 Senate Omnibus***	FY04 Request	FY03 Request*	FY02 Actual	FY03 House**	FY03 Senate Omnibus***
FE (1)	**$578**	**$479**	**$651**	**$628**	**$519**	**8.3%**	**-10.1%**	**-20.2%**	**-17.3%**
EE	**$621**	**$596**	**$638**	**$589**	**$549**	**-7.9%**	**-11.7%**	**-14.0%**	**-6.8%**
ES	**$746**	**$734**	**$610**	**$772**	**$832**	**13.3%**	**11.6%**	**36.4%**	**7.7%**
RE	$383	$407	$396	$448	$444	9.1%	16.1%	12.2%	-0.9%
NE	$363	$327	$214	$324	$388	18.6%	6.8%	81.4%	19.6%
Science	**$3,309**	**$3,264**	**$3,271**	**$3,336**	**$3,275**	**0.3%**	**-1.1%**	**0.1%**	**-1.8%**
HEP	$697	$725	$725	$730	$738	1.8%	5.8%	1.8%	1.1%
NE	$351	$382	$382	$387	$389	1.8%	11.1%	1.8%	--
BER	$554	$484	$504	$531	$500	3.2%	-9.9%	-0.9%	--
BES	$980	$1,019	$1,020	$1,045	$1,009	-1.0%	3.0%	-1.1%	-3.4%
ASC	$150	$167	$175	$170	$173	4.2%	15.5%	-0.6%	2.3%
FU	$241	$257	$248	$259	$257	0.0%	6.7%	3.5%	-0.8%
O(2)	$336	$229	$217	$214	$208	-9.1%	-38.1%	-3.9%	-2.6%
EM (3)	**$195**	**$168**	**$213**	**$176**	**$171**	**2.0%**	**-12.2%**	**-19.8%**	**-2.9%**
Total	**$5,449**	**$5,240**	**$5,383**	**$5,501**	**$5,345**	**2.0%**	**-1.9%**	**-0.7%**	**-2.8%**

Notes:

(1) includes Clean Coal Technology

(2) includes energy research analysis, science laboratory infrastructure, mulitprogram energy labs-facility support, university & science education programs, facilities and infrastructure, safeguards and security, program direction, small business innovation research (Science only), and technical information management (managed by the Office of Scientific and Technical Information (OSTI) less security charges for reimbursable work, and less use of prior year balances. Prior to FY04, OSTI was funded under Energy Supply (at about $8 million) so previous year's Science budgets have been adjusted to be comparable.

(3) prior to fiscal year 2004, this was known as non-defense environmental management.

* from the "FY 2003 Amended Request" column in the FY 2004 Request to Congress
** as passed the House on July 11, 2003 (H.R. 5093) for Interior funded programs, for Energy & Water funded program, as reported by the House Appropriations Committee on September 24, 2002 (H.R. 5431)
*** as passed the Senate on Jan 15, 2003 in the H.J. Res. 2 Omnibus Appropriations. The FY03 Omnibus levels do not reflect a final 1.3% across the board reduction that was approved by the Senate but not applied to specific agencies and programs. They do, however, reflect the application of an earlier 1.6% across the board reduction.

Key to Abbreviations

FE	Fossil Energy R&D
EE	Energy Conservation R&D
ES	Energy Supply R&D
RE	Renewable Energy
NE	Nuclear Energy
Science	Science
HEP	High energy physics
NE	Nuclear Physics
BER	Biological & Environmental Research
BES	Basic Energy Sciences
ASC	Advanced Scientific Computing
FU	Fusion Energy Sciences
Oth	Other
EM	Non-Defense Site Acceleration Completion(3)

4. Witnesses Questions

Witnesses have been asked to:

1. Review the R&D budget request in the context of the Administration's overall priorities in science and technology.
2. Describe the mechanisms that the Administration uses to determine priorities across scientific disciplines.
3. Describe the mechanisms the Administration uses to coordinate its scientific research and technical development activities with other federal agencies.

5. Budget Charts for Selected Interagency Programs

National Nanotechnology Initiative

(Numbers in Millions)

	FY02 Actual	FY03 Request	**FY04 Budget**	Change FY03-04	
				Amount	Percent
NSF	204	221	**249**	28	12.67%
Defense	224	243	**222**	-21	-8.64%
Energy	89	133	**197**	64	48.12%
NASA	35	33	**31**	-2	-6.06%
Commerce	77	69	**62**	-7	-10.14%
NIH	59	65	**70**	5	7.69%
Other	9	10	**18**	8	80.00%
Total	697	774	**849**	75	9.69%

Networking and Information Technology R&D

(Budget Authority in Millions)

	FY02 Actual	FY03 Request	**FY04 Budget**	Change FY03-04	
				Amount	Percent
Commerce	36	38	**39**	1	2.63%
Defense	439	442	**461**	19	4.30%
Energy	306	310	**317**	7	2.26%
EPA	2	2	**2**	0	0.00%
HHS	347	374	**441**	67	17.91%
NASA	181	213	**195**	-18	-8.45%
NSF	662	678	**724**	46	6.78%
Total	1973	2057	**2179**	122	5.93%

Global Change Research Program

(Budget Authority in Millions)

	FY02 Actual	FY03 Request	**FY04 Budget**	Change FY03-04	
				Amount	Percent
NSF	189	203	**213**	10	4.93%
Energy	117	129	**133**	4	3.10%
Commerce	100	118	**136**	18	15.25%
Ag	55	66	**73**	7	10.61%
Interior	26	26	**26**	0	0.00%
EPA	21	22	**22**	0	0.00%
NIH	56	59	**61**	2	3.39%
NASA	1090	1112	**1068**	-44	-3.96%
All Other	12	12	**17**	5	41.67%
Total	1666	1747	**1749**	2	0.11%

Chairman BOEHLERT. Good morning. It is a pleasure to welcome everyone here today for the opening of the fiscal year 2004 budget season for research and development. I think I can speak for everyone when I say that I hope it doesn't last as long as the fiscal year 2003 season has. It hasn't been a pretty process, to say the least, but the critic William Dean Howells once said that what Americans want is a tragedy with a happy ending. And that seems to be a pretty good description of the fiscal year 2003 appropriations process when it comes to R&D.

While we're just beginning to get the full picture now, we do know, for example, that the National Institutes of Health and the National Science Foundation faired quite well, receiving sizable increases despite tight budgetary constraint. Everybody applaud here.

The 11 percent or so increase for NSF raises a fundamental question about how to read the Administration's fiscal year 2004 request. Are we to focus on the fact that it includes a nine percent increase for NSF, a major show of support in this budget, or are we to focus on the proposed dollar amount, which with the new appropriation numbers, represents an increase slightly above inflation. Because the Congress has so delayed making its spending decisions for this year, it's virtually impossible to know how to interpret the Administration's proposal for next year. I hope we can begin to sort that out today. If nothing else, the appropriations delay may give the Administration time to reconsider some of its budget proposals. And I am sure that process is taking place as we meet.

There are many positive aspects of the budget request, like the new laboratory money for the National Institutes of Standards and Technology and reasonable increases for the National Oceanographic and Atmospheric Administration and a healthy increase for the National Nanotechnology Initiative, something that we are enamored with. But there is much to cause distress as well like the virtual elimination of the Advanced Technology Program and the Manufacturing Extension Partnership and flat funding for the Department of Energy Office of Science.

I may have said this last year as well, but the concern expressed for the physical sciences in the budget reminds me a little bit of the joke about the will that said to Joe, "I said I would mention you in my will. Hello, Joe." Sympathy won't fund labs. There are also many areas of the budget that look promising, but where there is still a lot to learn. Those areas include Homeland Security. And I have just been advised yesterday by the Speaker that I will be on that Committee, also, where we still don't have a clear picture of what science and technology work will be funded in the new department or where it will be carried out. The President's Hydrogen Initiative, which appears to be an excellent focus of research but where many questions about its agenda and funding remain and climate change where, so far, well-intended Presidential Initiatives haven't quite lived up to their billing.

So we have plenty of questions to pursue today. I think we have before us a budget that demonstrates a genuine desire on the part of the Administration to give research and development its due. I think all of us will have to work hard if those desires are to be ful-

filled, some of them in ways that the Administration was not able to imagine.

[The prepared statement of Chairman Boehlert follows:]

PREPARED STATEMENT OF CHAIRMAN SHERWOOD L. BOEHLERT

It's a pleasure to welcome everyone here today for the opening of the fiscal year 2004 budget season for R&D. I think I can speak for everyone when I say that I hope it doesn't last as long as the fiscal '03 season has. It hasn't been a pretty process, to say the least.

But the critic William Dean Howells once said that what Americans want is a tragedy with a happy ending. And that seems to be a pretty good description of the fiscal '03 appropriations process when it comes to R&D. While we're just beginning to get the full picture, we do know, for example, that the National Institutes of Health and the National Science Foundation (NSF) fared quite well, receiving sizable increases despite tight budgetary constraints.

But the 11 percent or so increase for NSF raises a fundamental question about how to read the Administrations fiscal 04 request. Are we to focus on the fact that it includes a nine percent increase for NSF—a major show of support in this budget? Or are we to focus on the proposed dollar amount, which, with the new appropriations numbers, represents an increase that barely keeps up with inflation?

Because the Congress has so delayed making its spending decisions for this year, it's virtually impossible to know how to interpret the Administration's proposal for next year. I hope we can begin to sort that out today.

If nothing else, the appropriations delay may give the Administration time to reconsider some of its budget proposals. There are many positive aspects of the budget request—like new laboratory money for the National Institute of Standards and Technology (NIST) and reasonable increases for the National Oceanographic and Atmospheric Administration (NOAA) and a healthy increase for the National Nanotechnology Initiative.

But there's much to cause distress as well—like the virtual elimination of the Advanced Technology Program (ATP) and the Manufacturing Extension Program (MEP), and flat funding for the Department of Energy (DOE) Office of Science. I may have said this last year as well, but the concern expressed for the physical sciences in the budget reminds me a little bit of the old joke about the will that said, "To Joe, who I said I would mention in my will, 'hello, Joe.'" Sympathy won't fund labs.

There are also many areas of the budget that look promising, but where there's still a lot to learn. Those areas include Homeland Security, where we still don't have a clear picture of what science and technology work will be funded in the new Department or where it will be carried out; the President's hydrogen initiative, which appears to be an excellent focus of research, but where many questions about its agenda and funding remain; and climate change, where, so far, well intended Presidential initiatives haven't quite lived up to their billing.

So we have plenty of questions to pursue today. I think we have before us a budget that demonstrates a genuine desire on the part of the Administration to give research and development its due. I think all of us will have to work hard if those desires are to be fulfilled, some of them in ways that the Administration was not able to imagine.

Chairman BOEHLERT. The Chair is pleased to call on the Ranking Member and distinguished gentleman from Texas, Mr. Hall.

Mr. HALL. Mr. Chairman, thank you very much and thanks for your jokes. Back when I was a judge, they used to say, "Give me a fair trial and turn me loose." I join you in welcoming this very distinguished panel. This will be the Committee's initial review of the President's fiscal year 2004 budget request for federal R&D programs, along with the associated policy issues raised by the budget allocations. The Chairman has scheduled a separate hearing later this month for the review of the NASA report and any revisions made necessary in the aftermath—understandably made necessary in the aftermath of the tragic loss of the Columbia.

Because of the drawn out fiscal year 2003 appropriations process, we are in an unusual situation, unusual position of having no fund-

ing numbers for the current fiscal year with which to compare the request before us. Consequently, I expect there will be differing interpretations of the impact that this budget request will have on the Nation's R&D enterprise. Nor would I be surprised if the Administration's suggestions—the revisions that they have to set forth to the request once fiscal year 2003 appropriations are approved. So we will have to wait and see on that. However on balance, I think R&D fares fairly well in a difficult budget year.

I suspect that most observers are not surprised to see the heavy focus on the request on R&D for national defense and homeland security. I hope Dr. Marburger can tell us more about how the increased funding for the new Department of Homeland Security is going to be spent.

Of particular interest to me is how its research activities are going to be coordinated with the relevant activities of the other R&D agencies. I also hope to learn more about the Administration's evolving policies for balancing the requirements of openness and information that the public seems to always want to that dissemination and the conduct of scientific research with the needs for national security. It is something you have got to look there at both and keep both in the computer.

Along with many of my colleagues, I have been concerned about the decline of research financing for the physical sciences and engineering relative to the biomedical sciences. While I support and did support the funding increase NIH has received, a lot of the scientists have pointed out that related fields with advances in basic understanding in such fields as physics, chemistry, and mathematics are very important at this time and in this day.

And so I am pleased, I think, to see the increased attention in the budget proposal to the need for strengthening research in the physical sciences and engineering, although the message of the budget is mixed, I think, in this regard. Maybe this panel can help us. It is unclear to me why DOD's basic and applied research activities, which are a major source of support for research in the physical sciences and engineering, fared so poorly in this budget. Also, I note that phasing down construction of the Spallation Neutron Source has freed funding for proposed new research activities by the DOE Office of Science. Nevertheless, the total funding level for the Office would remain flat for the third year in a row.

Relative to other energy R&D activities, I still remain concerned that funding for oil and gas development programs continues to be cut while domestic production continues to decline at an ever-increasing-rate and industry research programs have been largely closed out. And the Senate struck out on passing the Energy Bill last session, as they struck out on the passing of a lot of things that were in conference. If the Federal Government doesn't step into the breach, then I don't know how we can expect to minimize our dependence on foreign oil in the next 10 years. And that is important. That is the long range, but I don't know how we are going to tolerate it even for the next year. We depend on them for, what, 50 or 60 percent of our oil when we have plenty right here at home. We have plenty in ANWR. If we would pass the drilling of the depths of the ocean to take us past the 5,700 feet that we can drill

now, we could certainly do without all of the reliance on a bunch of OPEC hijackers that don't like us.

And with that, Mr. Chairman, I thank you for calling this hearing, and I thank you for having these witnesses and appearing before the Committee today. And I look forward to our discussions.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF RALPH M. HALL

I want to join Chairman Boehlert in welcoming our distinguished panel of witnesses to this morning's hearing. This will be the Committee's initial review of the President's fiscal year 2004 budget request for federal R&D programs, along with the associated policy issues raised by the budget allocations. The Chairman has scheduled a separate hearing later this month to review the NASA request and any revisions made necessary in the aftermath of the tragic loss of the shuttle Columbia.

Because of the drawn out FY 2003 appropriations process, we are in the unusual position of having no funding numbers for the current fiscal year with which to compare the request before us. Consequently, I expect there will be differing interpretations of the impact this budget request will have on the Nation's R&D enterprise. Nor would I be surprised if the Administration suggests revisions to the request once FY 2003 appropriations are approved. However on balance, I believe R&D fares fairly well in a difficult budget year.

I suspect that most observers are not surprised to see the heavy focus in the request on R&D for national defense and homeland security. I hope Dr. Marburger can tell us more about how the increased funding for the new Department of Homeland Security will be spent.

Of particular interest to me is how its research activities will be coordinated with the relevant activities of the other R&D agencies. I also hope to learn more about the Administration's evolving policies for balancing the requirements of openness and information dissemination in the conduct of scientific research with the needs of national security.

Along with many of my colleagues, I have been concerned about the decline in research funding for the physical sciences and engineering relative to the biomedical sciences. While I supported the funding increases NIH has received, many scientists have pointed out the connection between progress in the health-related fields with advances in basic understanding in such fields as physics, chemistry and mathematics.

Therefore, I am pleased to see increased attention in the budget proposal to the need for strengthening research in the physical sciences and engineering, although the message of the budget is mixed in this regard. It is unclear to me why DOD's basic and applied research activities, which are a major source of support for research in the physical sciences and engineering, fare so poorly in this budget. Also, I note that phasing down construction of the Spallation Neutron Source has freed funding for proposed new research activities by the DOE Office of Science. Nevertheless, the total funding level for the Office would remain flat for the third year in a row.

Relative to other energy R&D activities, I remain concerned that funding for oil and gas development programs continues to be cut while domestic production continues to decline at an ever increasing rate and industry research programs have been largely closed out. If the Federal Government doesn't step into breach, then how can we expect to minimize our dependence on foreign oil in the next 10 years?

Finally, I would like to explore with our witnesses the rationale and justification for the plan to phase out funding for the Manufacturing Extension Partnership Program. This program has received strong support from the National Association of Manufacturers, the National Governors Association, and thousands of small manufacturers across the Nation. We should carefully weigh the arguments that would justify this action.

I want to thank Chairman Boehlert for calling this hearing and all our witnesses for appearing before the Committee today. And I look forward to our discussions.

Chairman BOEHLERT. Thank you very much, Mr. Hall. Our panel today is consisting of very distinguished Americans who are dedicated in their public service and are in very demanding jobs: Dr. John H. Marburger, Director of the Office of Science and Technology and Policy; Dr. Samuel W. Bodman, Deputy Secretary, U.S. Department of Commerce; Dr. Rita R. Colwell, Director of the Na-

tional Science Foundation; and Mr. Robert G. Card, Under Secretary for Energy, Science, and Environment at the U.S. Department of Energy. Please enlighten us. Dr. Marburger, you start.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF REPRESENTATIVE NICK SMITH

Our Science Committee had a very productive 107th Congress, with the President signing eighteen Committee initiatives into law, including legislation I was fortunate that strengthens research and education efforts and dramatically increases authorization for research funding at the National Science Foundation. The Committee's agenda for the 108th Congress will be busy also, and hopefully, just as productive. I am looking forward to working with Chairman Boehlert and Ranking Member Hall to help continue the Committee's record of success.

The new priorities of security for this country and the reorganization that occurred with the creation of the Department of Homeland Security make interpretation and analysis of the budget challenging. With regard to the overall budget picture, though, one thing is abundantly clear: we must do a better job of prioritizing our needs and our wants, and ultimately make some tough decisions to reign in spending. NSF spending for FY04 will not have the increase that we had in FY03. While the war on terror and the associated defense spending increases are necessary, we need to conduct a critical reevaluation of the remainder of non-defense discretionary spending. This means the research community must also examine ways the taxpayer might get more bang for their buck (if you will).

With regard to research and development, I believe the President's budget provides less than appropriate support for the Federal Government's science agencies, even with the bleak budget outlook. NSF funding should not be less than the average for discretionary spending. The suggested nine percent increase, which is 3.2 percent after adjusting for the final FY03 appropriation level, is 14 percent below the authorized level. However, I believe the R&D budget appropriately focuses on the most important research issues of the day, such as defense, homeland security, the physical sciences, and nanotechnology.

A significant amount of this new focus on physical sciences research will be directed to the National Science Foundation. As Chairman of the Research Subcommittee and a longtime supporter of the need to achieve a better balance between funding of the math and physical sciences and that of the biomedical sciences. As the only agency in government to receive a "green light" from OMB—two green lights as a matter of fact—NSF has shown itself to be a model of well-managed government. There is, of course, always room for improvement.

While I understand that my NSF authorizing legislation did not become law until very late in the Administration's budget planning process, I commend Director Colwell for her efforts to begin to meet several of the requirements of the bill in this budget, including those provisions related to the Major Research Equipment account. I am interested in working with NSF to see several other Committee priorities come to fruition, such as the Plant Genome and Gene Expression Centers and the Centers for Research on learning in Math and Science.

I would like to thank the witnesses for appearing before us today to discuss this issue, and I am looking forward to a productive discussion as we begin to move ahead in the budget process.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good morning. I want to thank the witnesses for appearing before our committee to discuss the President's FY04 Budget for Research and Development. Today's hearing serves as an opportunity for oversight of certain departmental programs. As you are aware, a number of trends spotted in last year's budget submission are seen again in the FY03 budget, including reversal of the trend toward parity in defense and non-defense R&D, the marginal increase in the National Science Foundation budget, and targeting of cooperative government-industry programs for cuts.

There are a number of new initiatives that build upon the current direction in scientific research, as well as a number of previous initiatives that have been introduced in a new format. However, I was disappointed to see that the Administration's budget increased the NSF budget below the 15 percent increase needed to meet the 5-year budget doubling called for in the NSF authorization statute enacted last year and cut many important Department of Energy programs.

The Department of Energy's Fossil Energy Research and Development program impacts my congressional district because the coal industry is of great importance to the economy and livelihood of my constituents in Southern Illinois. As you may know, this area is rich in high-sulfur coal. The shifting of production to low-sulfur coal has cost many of my constituents high-paying jobs. Implementing the coal research program, which includes the clean coal technology program, is significant to my district, and I look forward to learning more about planned spending in this area.

I was displeased to see the Advanced Technology Program and the Manufacturing Extension Partnership Center were both eliminated in the President's budget. These programs help businesses increase competitiveness, efficiency and productivity—exactly what our economy needs to get back on track.

Finally, I am pleased to see an increase over the current appropriation for Renewable Energy Resources. Non-fossil energy sources including ethanol, solar power, and wind energy are extremely important initiatives and I believe we should dedicate more resources toward these programs.

I welcome our panel of witnesses and look forward to their testimony.

STATEMENT OF DR. JOHN H. MARBURGER, III, SCIENCE ADVISOR TO THE PRESIDENT; DIRECTOR, OFFICE OF SCIENCE TECHNOLOGY AND POLICY

Dr. MARBURGER.* Thank you, Mr. Chairman and Members of the Committee. It is a pleasure to meet with you today to discuss the President's federal research and development budget for fiscal year 2004.

I thank you for your bipartisan and enduring support of our country's research and engineering enterprise and look forward to continuing that positive relationship in the future.

In that connection, Congressman Hall, you referred to issues of science and openness and security. I know we had some questions from you that we had hoped to answer prior to this hearing. These are important questions, and we certainly want to be responsive on that issue, and I will answer your questions today.

Mr. HALL. They were due the 7th, and we really needed them for this hearing. And we would appreciate if you would answer them, and I would have appreciated it if you had answered them. Thank you for the explanation.

Dr. MARBURGER. Understood. We have been busy. The President's budget focuses on winning the war on terrorism, securing the homeland, and strengthening the economy. The President's budget requests another record high level of funding for R&D: 123 billion or a seven percent increase over the 2003 request. This budget is about priorities, and it should be noted that six* and a half billion of the R&D increase is in Department of Defense development activities, reflecting the President's commitment to bolster our national defense and to win the war against terrorism.

Within the remaining increase, priorities have been established, and I will go through them briefly in my oral statement, but much more detail can be found in my written testimony, which I would ask be made part of the record at this time.

Chairman BOEHLERT. All statements, in their entirety, are part of the official record.

Dr. MARBURGER. And I should mention, before I get into the details, and in the absence of a final '03 appropriation, the figures that I will refer to when I talk about percentage increases and decreases over last year, used the President's '03 request as a base.

We don't have another base to refer to, and that is what those percentages will mean.

In preparing this budget, the Administration has taken advice from the numerous planning and advisory bodies that exist to guide science priorities, including the President's Council of Advisors on Science and Technology and the Committees formed under the National Science and Technology Council. We also heard and responded to concerns raised in this very Committee room, and we thank members of this committee for their interest in advocacy for science and technology.

So let me briefly highlight the various R&D agency budget just to get us started and the interagency initiatives within this committee's jurisdiction. First, the National Science Foundation, which Mr. Chairman, you mentioned. The '04 budget request would increase the overall NSF budget by $453 million, or about nine percent relative to the '03 request. The investment for physical science at NSF would increase by $100 million, or 13 percent. In addition, in this budget proposal, individual awards for graduate stipends in science and engineering are increased from $25,000 to $30,000 annually, and the total number of awards is increased. I think this is an important initiative.

Within the Department of Energy, there are several exciting new presidential research initiatives announced recently, including the $1.2 billion Hydrogen Fuels Initiative and the President's commitment for the U.S. to enter into negotiations to participate in building the international thermonuclear experimental reactor ITER. It is an exciting program.

The DOE budget provides $5.2 billion for federal science and technology at DOE, a three percent increase from the '03 request. The request for the Office of Science provides $3.3 billion, which includes planned reductions in construction funding for the Spallation Neutron Source. So while the overall growth of the Office of Science budget is only—is 1.7 percent, $55 million over the '03 request, when you consider the amount of funding previously committed to SNS construction that is now being redirected toward research investments in the Office of Science, the real increase for research spending there would be $140.5 million or 4.6 percent.

In NASA, the President's request represents a total funding increase of nine percent and nearly 9.2 billion dollars for Federal Science and Technology programs. The Federal Science and Technology category is a category recommended by the National Academy that excludes most development activities and gives a more accurate picture of the basic research.

I understand the Committee has a separate hearing planned for NASA, so I won't go into more detail here, but we are happy to address questions as they come up.

The Department of Commerce budget provides $851 million for Federal Science and Technology programs, including $57 million for NOAA's Sea Grant Program, which has been reformed to move increasingly toward merit-based research funding.

In the Environmental Protection Agency, the budget provides $776 million in Federal Science and Technology category. While the '04 EPA figure appears to be decreased slightly from the President's request from last year, that request actually included a one-

time expenditure for the Anthrax clean up at the Hart Building. And if you back out this funding, the '04 request actually equates to about a $30 million* increase in EPA's science and technology budget.

Also, responding to concerns raised by this committee and others about the adequacy of science at EPA, the Agency has approved a science advisor to improve science integration and coordination across the Agency.

Within the Department of Transportation, the request provides $606 million for Federal Science and Technology at DOT, an increase of 11 percent, including $100 million for the Federal Aviation Administration to maintain its focus on safety and environmental research.

Department of Homeland Security, because it is a new department with significant federal R&D responsibility, it is important to mention that this department will house a science and technology directorate that will support the conduct of R&D for developing countermeasures to chemical, biological, radiological, and nuclear weapons and other terrorist threats. The President's request for direct activities within this directorate is $803 million. There is obviously a substantial amount of coordination with research in other agencies that is going to be required there.

There are important interagency initiatives: Combating Terrorism. The President has proposed $3.2 billion in R&D funding for homeland security across agencies. Over $900 million is requested in '04 for combating terrorism research and development in the new department, including the $803 million that I mentioned before. Networking and Information Technology, we provide $2.2 billion in this request for that initiative, a six percent increase over last year's budget. The largest increase is proposed for the Department of Health and Human Services, recognition of the importance of bioinformatics, which would increase by $67 million or 18 percent in that—in HHS.

The National Nanotechnology Initiative provides for $792 million* for that initiative, a 6.7 percent increase over '03 request levels. The DOE's Office of Science almost triples its investment in new nanoscale science research centers. That is using the money available from the SNS [Spallation Neutron Source] construction roll-off, including construction on three* new nanoscience research centers, bringing the total number of funded centers to five.

Climate change: last year, to advance climate change science objectives, President Bush created the Climate Change Research Initiative, which we have heard a lot about. This program involves 12 federal agencies. While the combined funding for that program, for the research program, remains level with 2003, the funds identified for the CCRI Initiative are increased to $182 million as compared with 40 million in the previous request.

Math and science education: the improvement of pre-K through 12 math and science education remains a major Administration priority that is reflected in the budgets of the National Science Foundation, the Department of Education, and the National Institute of Child Health and Human Development. Special emphasis is placed on the successful development and implementation of evi-

dence-based educational programs and practices as called for in the No Child Left Behind Act of 2002.

Mr. Chairman, this is a good budget for science. I think that there is an unambiguous message here that this Administration supports basic research and physical science research, and I urge the Committee to support it. I look forward to answering your questions.

* Dr. Marburger's oral statement contained some references to numbers that should have been corrected to be consistent with the more accurate numbers in his written testimony. See Dr. Marburger's written statement for correct figures.

[The prepared statement of Dr. Marburger follows:]

PREPARED STATEMENT OF JOHN H. MARBURGER, III

Mr. Chairman and Members of the Committee, it's a pleasure to meet with you today to discuss the President's federal research and development budget for fiscal year 2004.

As I testified last year, I am committed to maintaining a close and productive relationship with this committee. I applaud your bipartisan and enduring support of our country's research and engineering enterprise, and look forward to continuing our relationship as we make important choices together to optimize the federal R&D investment.

The President's budget focuses on winning the war on terrorism, securing the homeland, and strengthening the economy. Considering the context of an uncertain economic environment and growing federal deficit, any increase in discretionary spending is difficult to justify to the American people. However, the President's budget requests another record high level of funding for R&D: $123 billion or a seven percent increase over the 2003 request. Over $5.9 billion of the increase is in Department of Defense development activities, reflecting the President's commitment to bolster our national defense and homeland capabilities.

This increase in R&D spending is evidence of the great importance the Administration places on science and technology in addressing our country's present and future challenges. The President's budget also continues to emphasize improved management and performance to maintain excellence and sustain our national leadership in science and technology.

In my statement I will review the broad goals of the President's budget and a provide detail on federal research priorities that cut across multiple agencies and research disciplines. I should point out that, in the absence of a final FY 2003 budget, the figures reflected in terms of percentage increases for comparison purposes use the President's FY 2003 budget as a base.

THE PRESIDENT'S FY 2004 R&D BUDGET

Our President has a strong commitment to research and discovery in the national interest. When earlier this month we endured the tragic loss of the space shuttle Columbia, the President was unequivocal in his promise that, despite setbacks, the journey of discovery would go on. He said:

> *This cause of exploration and discovery is not an option we choose; it is a desire written in the human heart. We are that part of creation which seeks to understand all creation.*

The programs in the federal R&D budget represent some extraordinary new vistas of science with the potential to revolutionize our understanding and our capabilities. We cannot fund everything we'd like, but we will fund those exciting and high priority initiatives that keep this dream of discovery alive, and we will set the stage for the next generation scientists and engineers to take up new challenges that we cannot even imagine.

In preparing this budget, the Administration has taken advice from the numerous planning and advisory bodies that exist to guide science priorities. For example, the budget begins to respond to recommendations by the President's Council of Advisors on Science and Technology (PCAST) and others about needs in physical science and engineering. The budget also reflects an extensive process of consultation between the federal agencies, OMB, and OSTP, to thoroughly understand agency programs and priorities, interagency collaborations, and directions for the future. The National Science and Technology Council (NSTC), which I will discuss later in my tes-

timony, provided a valuable mechanism to facilitate this interagency coordination. This process resulted in guidance to agencies issued by OSTP and OMB last May, concerning their program planning, evaluation, and budget preparation, and culminating in the budget you see before you today.

The result is a budget that includes a strong emphasis on basic research across the agencies. Basic research is the source of tomorrow's discoveries and new capabilities, and this long-term research will fuel further gains in economic productivity, quality of life, and national security. Included in the budget, and emphasized in my comments today, is the budget category Federal Science & Technology (FS&T). This category, introduced in response to a recommendation of the National Academy of Sciences, excludes most of the development activities in the federal R&D budget, including Department of Defense development, thereby only highlighting those activities devoted specifically to the creation of new knowledge and technologies.

The budget includes an increase in emphasis on the physical sciences. The physical sciences not only spur understanding of the universe, they are the theoretical foundation for a host of new and promising technologies. Physical science research also offers education and training opportunities vital for a technologically advanced society.

The budget also highlights investments in important research conducted by multiple federal agencies in a coordinated fashion. Increasingly, the cutting edge of research is not cleanly confined to a specific science discipline, but spans a variety of disciplines or applications. Well-managed interagency collaboration takes advantage of the vast pool of capabilities represented across the Federal Government while minimizing new organizational structures. The high-priority multi-agency R&D initiatives for FY 2004 are: combating terrorism R&D, network and information technology, nanotechnology, climate change research and technology and education research.

AGENCY BUDGET HIGHLIGHTS

The Office of Science and Technology Policy (OSTP) has primary responsibility in the White House to coordinate interagency research initiatives, so I will concentrate my testimony on those initiatives and give only brief highlights of the budgets of several agencies within this committee's jurisdiction.

National Science Foundation (NSF):

The proposal would increase the overall NSF budget by $453 million, or about nine percent relative to the FY 2003 Presidential request.

- The budget invests heavily in the physical sciences: NSF physical science investments would increase by $100 million, or 13 percent. Fundamental discoveries in the physical sciences are needed to spur progress in other areas, such as health research, energy, agriculture and the environment.
- The 2004 budget continues a multi-year effort to improve attraction and retention of U.S. students into science and engineering careers by increasing annual graduate student fellowship and training stipends from $25,000 to $30,000 and increasing the number of awards. Reducing the financial burden graduate students face can have a significant impact on their choice of science or engineering as a career.
- The Major Research Equipment and Facility Construction program will receive a 60 percent increase to a total of $202 million in 2004. Simultaneously, NSF is taking a close look at their investments and priorities in research infrastructure, and has, for the first time, provided the Congress with a rank ordering of its approved large facility construction projects and a discussion of how these projects were selected, approved and prioritized.

Department of Energy (DOE):

The budget provides $5.2 billion for federal science and technology at the DOE, a three percent increase from the 2003 request. The FY 2004 budget for DOE reflects the phasing down of construction funding for the Spallation Neutron Source, enabling additional funding to be redirected toward research.

- The recently announced $1.2 billion Hydrogen Fuel Initiative includes $720 million in new funding proposed over the next five years to develop the technologies and infrastructure needed to produce, store and distribute hydrogen fuel for use in fuel cell vehicles and electricity generation.
- The budget includes $12 million to support the President's recently announced commitment for the U.S. to enter into negotiations with international parties to participate in building ITER, the next milestone on the path towards developing fusion as a commercially viable energy source.

- The budget proposes $3.3 billion for DOE's science programs, an increase of $55 million over 2003. This includes increased emphasis on support for physical sciences research, including nearly tripling the investment in new centers for nanoscale science research.

National Aeronautics and Space Administration (NASA):

The President's request for NASA represents a total funding increase of nine percent for R&D and nearly $9.2 billion for FS&T programs, a five percent increase.

- The President's commitment to space exploration is evident in this budget, which was conceived before the tragic loss of the Columbia astronauts. Total funding for NASA is proposed to increase 3.1 percent overall. The Shuttle budget, after taking into account the transition to full cost accounting, receives nearly a five percent increase over 2003.
- Included in the $4 billion in space science programs are several initiatives to increase the scientific and educational outcomes of future planetary missions, such as a new $31 million investment in optical communications technology and a $279 million investment in Project Prometheus, to include the development of propulsion systems that will enable exploration of our solar system's most distant planets.

Department of Commerce:

The budget provides $851 million for FS&T programs, an increase of one percent.

- The budget provides increased funding for National Institute of Standards and Technology (NIST) laboratories' upgrades, maintenance and repairs, and an increase of over $10 million for homeland security standards development related to biometric identification, threat detection, and high-rise safety.
- The Advanced Technology Program (ATP) is terminated consistent with the Administration's emphasis on shifting resources to reflect changing needs. Funding is provided for administrative costs and close-out. Additionally, the budget maintains the 2003 policy of limiting federal funding for the Manufacturing Extension Partnership (MEP).
- The budget provides $57 million for NOAA's Sea Grant College Program, which is working to move increasingly towards merit-based funding of research.

Environmental Protection Agency (EPA):

The budget provides $776 million in the FS&T budget for EPA, essentially maintaining funding at the level requested in the FY 2003 Budget.

- The EPA budget supports significant efforts to continue to improve the scientific base in support of policy and regulations through: improvement of the use of science by the regional offices; ongoing efforts to attract and maintain a high-quality, diverse scientific workforce; and assessments to ensure the quality and consistency of science.
- Responding to concerns about the adequacy of its science, EPA has appointed an agency Science Advisor to improve environmental science integration and coordination at EPA.
- The President's Budget provides nearly a four-fold increase in funding to improve the Integrated Risk Information System (IRIS), a database which contains toxicity information of chemicals. IRIS is used by other federal agencies, states, and international officials to help assess the potential health risks of chemicals and to develop regulations.

Department of Transportation (DOT):

The budget provides $606 million for FS&T at the DOT, an increase of 11 percent.

- The National Highway Traffic Safety Administration is provided an increase of $14 million for R&D in crash worthiness, crash avoidance, and data analysis to help reduce highway fatalities and injuries.
- The budget provides $100 million for the Federal Aviation Administration to maintain its focus on safety and environmental research.

Department of Homeland Security (DHS):

Finally, because it is a new department with significant federal R&D responsibility, it is important to mention that the Department of Homeland Security will house a science and technology directorate that will support the conduct of R&D for developing countermeasures to chemical, biological and radiological and nuclear

weapons and other terrorist threats. The 2004 request for direct activities of the S&T Directorate is $803 million.

INTERAGENCY INITIATIVES

Beyond the individual agency initiatives, the President's budget outlines priority areas of research involving multiple agency participation. Last May, OMB Director Mitch Daniels and I sent out an FY 2004 budget-planning memo to agencies to provide guidance and focus for these budget priorities. National R&D priorities set forth in the guidance memo include: R&D for Combating Terrorism, Networking and Information Technology, Nanotechnology, Climate Change, Molecular Life Processes and Education.

A mechanism for coordinating interagency initiatives lies within the President's National Science and Technology Council (NSTC), and my office has responsibility for the day-to-day operations of the NSTC. This Cabinet-level Council is the principal means for the President to coordinate science, space, and technology, bringing together the diverse parts of the federal research and development enterprise. The Council prepares research and development strategies that are coordinated across federal agencies to form an investment package aimed at accomplishing multiple national goals. The following describe high priority interagency initiatives the NSTC helps to coordinate:

Combating Terrorism—Last month the Department of Homeland Security opened its doors for business. Standing up the new Department is a massive undertaking and one of the highest priorities of this Administration. The President has proposed $3.2 billion in research and development funding for homeland security and combating terrorism across the Federal Government. Over $900 million is requested for combating terrorism research and development in the new department, including $803 million in the S&T directorate. This investment will be focused on robust research, development, testing, evaluation and systems procurement to ensure both evolutionary and revolutionary capabilities.

The National Science and Technology Council's Committee on Homeland and National Security will work with the Homeland Security Council, the National Security Council, the Office of Management and Budget, the Department of Homeland Security and other relevant departments and agencies to identify priorities for and facilitate planning of homeland and national security R&D. The coordinated federal effort will emphasize:

- Strategies to combat weapons of mass destruction, including radiological and nuclear countermeasures and biological agent detection, diagnostics, therapeutics, and forensics;
- Information analysis;
- Social, behavioral, and educational aspects of combating terrorism;
- Border entry/exit technologies; and
- Developing standards relevant to both homeland and national security.

Networking and Information Technology—The President's 2004 budget provides $2.2 billion for the Networking and Information Technology R&D Program (NITRD). This is a six percent increase over last year's budget. The largest increase above 2003 NITRD funding levels is proposed for the Department of Health and Human Services, which would increase by $67 million, or 18 percent. The increased life sciences budget reflects the growing importance of bioinformatics R&D—efforts at the intersection between biology and information technology—in furthering biomedical research. NSF maintains the largest share of NITRD program funding and the budget proposes a $45 million, or seven percent, increase.

Agencies involved in developing or using high end computing are engaged in planning activities coordinated through the National Science and Technology Council's Committee on Technology. In 2004, NITRD research emphases include:

- Network "trust" (security, reliability, and privacy);
- High-assurance software and systems;
- Micro- and embedded-sensor technologies;
- Revolutionary architectures to reduce the cost, size, and power requirement of high end computing platforms; and
- Social and economic impacts of information technology.

National Nanotechnology Initiative—The President's 2004 budget provides $849 million for the multi-agency National Nanotechnology Initiative (NNI). This is a 9.8 percent increase over 2003 levels. The Office of Science at the Department of Energy almost triples its investment in new nanoscale science research centers, with a pro-

posed increase of $63 million to begin design and construction on four new nanoscience research centers, bringing the total number of funded nano-centers to five. NSF continues to have the largest share of federal nanotechnology funding, reflecting the broad mission of NSF in supporting fundamental research across disciplines, and the budget for NIH nanotechnology activities is increased by almost eight percent. Altogether, 10 federal agencies cooperate in the nanotechnology initiative with activities coordinated through the National Science and Technology Council's Committee on Technology. The NNI strategy for 2004 involves further investment in fundamental research across the range of scientific and engineering disciplines through investments in investigator-led activities at colleges and universities, centers of excellence, and supporting infrastructure.

Responding to a recent National Research Council recommendation, next month the President's Council of Advisors for Science and Technology (PCAST) will begin conducting an ongoing, external review of the NNI aimed at strengthening the program and helping to identify and measure progress toward strategic goals.

Climate Change—Last year, to advance climate change science objectives, President Bush created the Climate Change Research Initiative (CCRI). The CCRI was combined with the existing U.S. Global Change Research Program (USGCRP) to create the Climate Change Science Program (CCSP), an interagency research effort involving 12 federal agencies. While funding for the combined CCSP remains level with 2003, the funds identified for CCRI is increased to $182 million as compared with $40 million in FY 2003. The CCRI investment will develop resources to support policy-making, provide computer resources for climate modeling for decision support studies, and enhance observations and data management for a climate observing system. The increase for CCRI is the result of a process that has focused on managing GCRP funding more effectively and refocusing some research toward CCRI goals. A draft strategic plan for the CCSP has been produced and vetted through the science community using a multi-day public workshop held in December 2002 and in an open comment period. The response was overwhelmingly in support of the new management approach to the federal program on climate change. A final strategic plan, relying on the extensive analysis and commentary resulting from the workshop, will be produced this spring and will guide the future activities of the program.

$40 million is identified for the National Climate Change Technology Initiative (NCCTI) Competitive Solicitation program—an innovative approach for funding technology research and development to reduce, avoid or sequester greenhouse gases. In 2004, government-wide spending on climate change technologies will be reviewed, and priority programs for emphasis in the NCCTI will be identified.

Math and Science Education—No Child Left Behind—The improvement of pre-K–12 math and science education remains a major Administration priority, with special emphasis on the successful development and implementation of evidence-based educational programs and practices, as called for in the No Child Left Behind Act of 2002. The President's 2004 budget request includes support for two such programs involving the federal research agencies: the Math and Science Partnership (MSP) Program and the Interagency Education Research Initiative (IERI). The MSP request for NSF is $200 million, and for the Department of Education is $12.5 million. The program funds new and ongoing partnerships between institutions of higher education and local school districts. This program also will fund teacher training summer institutes for more intense immersion into mathematics and science content areas.

The funding request for the IERI remains level with the President's 2003 budget request. The goal of the IERI is to improve pre-K–12 student learning and achievement in reading, math and science by conducting research on the scaling of educational practices that have already demonstrated their effectiveness in studies conducted with a limited number of students or classrooms. Currently the NSF, the Department of Education, and the National Institute of Child Health and Human Development (NICHD) participate in IERI.

Additionally, the 2004 budget includes a $10 million increase in research, development, and dissemination funding for the Department of Education's new "Institute of Education Sciences"—from $175 to $185 million.

Recognizing the need for better coordination of educational activities between the federal research agencies, the National Science and Technology Council's Committee on Science has formed a Subcommittee on Education. This subcommittee will advise on best practices and will develop strategies to move agency programs away from fragmentation and duplication of effort towards a coordinated, complimentary set of individual agency and interagency programs.

MANAGING THE FEDERAL RESEARCH BUDGET

Equal in importance to the spending on the federal research budget is the management of this investment. In addition to providing funding coordination, the NSTC will also be reviewing management aspects of research including:

- Analysis and recommendations concerning the requirements for federal investment in major research facilities and infrastructure, and the best management practices to determine priorities and allocate funding; and
- An investigation of the changing business model for research, and recommendations for modernizing the management and funding of federal research programs in response to this changing research environment.

The FY 2004 budget emphasizes increased return on investment by improvements in management, performance and results of the research programs. Working together and with the federal research agencies, OMB and OSTP are developing, implementing, and continuing to improve investment criteria for research programs across the government. Explicit R&D investment criteria have been developed to improve R&D program management, better inform R&D program funding decisions, and ultimately increase public understanding of the possible benefits and effectiveness of the federal investment in R&D. In 2004, all R&D program managers must demonstrate the extent to which their programs meet the following three tests:

- Relevance: R&D programs must be able to articulate *why* the investment is important, relevant, and appropriate. This must include complete planning with clear goals and priorities, clearly articulated societal benefits, and the mechanisms used for reviewing and determining the relevance of proposed and existing programs.
- Quality: R&D programs must justify *how* funds will be allocated to ensure quality. Agencies must maximize quality through clearly stated, defensible methods for awarding a significant majority of their funding. Programs must assess and report on the quality of current and past R&D.
- Performance: R&D programs must be able to monitor and document *how well* the investments are performing. This includes tracking and reporting annually on objectives and milestones for relevant programs, and defining appropriate measures of performance, output, and outcome.

As a result of implementing these criteria, and consistent with the Government Performance and Results Act, the Administration strives to ensure that every dollar is invested as effectively as possible. Based on lessons learned and other feedback, the Administration will continue to improve the R&D investment criteria and their implementation towards more effective management of the federal R&D portfolio.

CONCLUSION

Mr. Chairman and Members of the Committee, I believe this is a good budget for science and technology. I hope I have conveyed to you the extent of this Administration's commitment to advancing science and technology in the Nation's interest.

I look forward to our work together as we move towards implementing a national science and technology strategy that will draw from the best in industry, academia, the non-profit sector, and all levels of government. The programs that we discuss today will help us protect our citizens and our national interests, advance knowledge, promote education, and preserve the dream of exploration and discovery. I would be pleased to respond to questions about this budget.

BIOGRAPHY FOR JOHN H. MARBURGER, III

John H. Marburger, III, Science Adviser to the President and Director of the Office of Science and Technology Policy, was born on Staten Island, N.Y., grew up in Maryland near Washington D.C. and attended Princeton University (B.A., Physics 1962) and Stanford University (Ph.D. Applied Physics 1967). Before his appointment in the Executive Office of the President, he served as Director of Brookhaven National Laboratory from 1998, and as the third President of the State University of New York at Stony Brook (1980–1994). He came to Long Island in 1980 from the University of Southern California where he had been a Professor of Physics and Electrical Engineering, serving as Physics Department Chairman and Dean of the College of Letters, Arts and Sciences in the 1970's. In the fall of 1994 he returned to the faculty at Stony Brook, teaching and doing research in optical science as a University Professor. Three years later he became President of Brookhaven Science Associates, a partnership between the university and Battelle Memorial Institute that competed for and won the contract to operate Brookhaven National Laboratory.

While at from the University of Southern California, Marburger contributed to the rapidly growing field of nonlinear optics, a subject created by the invention of the laser in 1960. He developed theory for various laser phenomena and was a co-founder of from the University of Southern California's Center for Laser Studies. His teaching activities included "Frontiers of Electronics," a series of educational programs on CBS television.

Marburger's presidency at Stony Brook coincided with the opening and growth of University Hospital and the development of the biological sciences as a major strength of the university. During the 1980's federally sponsored scientific research at Stony Brook grew to exceed that of any other public university in the northeastern United States.

During his presidency, Marburger served on numerous boards and committees, including chairmanship of the governor's commission on the Shoreham Nuclear Power facility, and chairmanship of the 80 campus "Universities Research Association" which operates Fermi National Accelerator Laboratory near Chicago. He served as a trustee of Princeton University and many other organizations. He also chaired the highly successful 1991/92 Long Island United Way campaign.

While on leave from Stony Brook, Marburger carried out the mandates of the Department of Energy to improve management practice at Brookhaven National Laboratory. His company, Brookhaven Science Associates, continued to produce excellent science at the lab while achieving ISO14001 certification of the lab's environmental management system, and winning back the confidence and support of the community.

Chairman BOEHLERT. Thank you very much, Dr. Marburger. Dr. Bodman.

STATEMENT OF DR. SAMUEL W. BODMAN, DEPUTY SECRETARY, U.S. DEPARTMENT OF COMMERCE

Dr. BODMAN. Chairman Boehlert, Ranking Member Hall, ladies and gentlemen of the Committee, I am very happy and privileged to be here today to talk to you about the Commerce Department's budget with specific reference to NOAA and the technology administration. And I do so with enthusiasm, because we believe that this budget recognizes the importance of innovation in our economy, and the importance of innovation to our security and to our health and to our environment. We are very pleased and enthused about what we have to talk to you about this morning.

Before I get into the details of it, I felt that I would be remiss if I did not acknowledge at the outset the terrible loss that was suffered by the Federal Science community just 12 days ago with the loss of the Columbia Shuttle. Those astronauts were very courageous men and women who were devoted and dedicated to creating new knowledge. And I know that we all keep them in our minds and hearts, they and their families, as we go about our day-to-day lives here in Washington. My colleagues at NOAA and NIST work very closely at NASA, and so I can tell you that our broader Commerce family feels this loss very keenly.

The Commerce Department's budget request totals $5.4 billion, which is a five percent increase over the current year's request. Of this, the NOAA portion is $3.3 billion, or a six percent increase. TA's budget request is $505 million, a 12 percent decrease, but it includes $382 million, or a 10 percent increase for the core programs, the research programs, if you will, at the National Institute of Standards and Technology.

Just as Dr. Marburger has done, I have—and it was referred to by the Chairman, we have used the '03 budget request of the President as the baseline for these percentages.

Given the four percent or so constraint on the growth of all nonmilitary budgets, we believe that these are very fair and reasonable

budget requests and resource levels for the programs for which we are responsible. Further, I should mention that within these overall figures, we have significantly redirected our spending. That is to say we have accomplished a redirection by emphasizing four key priorities that are listed at the bottom of the slide before you: one, fostering our nation's economic growth; two, securing our homeland; three, upgrading our facilities with particular reference to the safety of those facilities so that we can meet our future mission and goals; and fourthly, to implement the Administration's Climate Change Research Initiative. These were the four things that we set out when I visited with OMB with the budget proposals.

In developing the request, Secretary Evans and I have taken the President's directive to focus on our top priorities, and this is necessitated that we make some very tough choices. I am going to run through the request, and I will point out some of the key elements in the some of the areas where we felt we had to make choices that I am sure are not going to be universally popular.

First, on NOAA, we request $3.3 billion, $190 million, or six percent above the current year's request. These funds will allow NOAA to advance our understanding of marine and atmospheric resources, and in so doing to help sustain this country's economic vitality and our environmental health. Our request supports all of the department's key priorities. For example, it requests—it reflects a total of $65 million, or a $7.7 million increase for homeland security efforts within NOAA, which will include an upgrade of the NOAA weather radio operation to become an all-hazard warning network, in other words to utilize the network that now exists and make it applicable to a wider range of threats to our homeland.

The request also includes funding for climate research, a topic of particular interest to this committee, I gauge from last year's meeting. And I would like to spend a few minutes on this particular subject.

One of the highlights of our request is $17 million increase proposed for NOAA's climate research. The $296 million total request includes research funding under the U.S. Global Climate Research Program. That figure of commerce is ticketed at $94 million or down $6 million from last year. The new Climate Change Research Initiative, which was the initiative proposed by the President, has $41.6 million and is up $23 million, $23.5 million on a year over year basis. Among other things, NOAA will use these funds to enhance our ocean observation systems and augment our carbon monitoring capabilities.

The USGCRP, the Global Climate Change Research Program, has been—was established over a decade ago, and this committee, I know, has followed it. And it has been the foundation of the Federal Government's multi-agency Climate and Global Change Research Program. The President's new CCRI builds on the past efforts of the GCRP with the ultimate goal of reducing present uncertainties and developing the necessary modeling capabilities to improve public policy-making.

As you know, our government's Climate Change Research Program is very large and very complex. It spans 13 federal agencies. Through enhanced coordination, a new interagency management framework has been created under the leadership of a Cabinet-

level Committee headed by Secretary Evans and Secretary Abraham.

[Slide]

On the chart before you, that is what we call the Gray Committee. We have carefully thought out the random selection of colors by the original people who prepared this chart. So the Gray Committee is the Cabinet-level Committee that oversees all of our efforts.

The blue box represents the interagency working group that is shared by Under Secretary Card and myself. This group meets bimonthly, and it discusses tradeoffs between science and technology. That is something that Dr. Marburger was very eager to see us do and that we were able to run this on a more integrated basis than had been the case before. We make policy recommendations to the Cabinet-level Committee.

The agency of science and technology efforts are coordinated individually and monitored closely by their respective program offices represented here in green at the bottom of the chart. The Commerce Department, under the direction of Assistant Secretary Jim Mahoney, coordinates the science side and our colleagues at Energy manage the technology side, shown on the right side at the bottom.

[Slide]

This next slide gives you a feel for the complexities involved in this working with 13 agencies. It shows the breakdown of funding across various contributing agencies. Even this time of—in this time of difficult budget decisions, the President is committed to fully funding climate research. He knows that we must use the tools of science to reduce uncertainties about our climate systems and in turn improve our decision-making.

As you can see, and as Dr. Marburger has pointed out, some funds are moving from USGCRP to the CCRI. The point here is to shift resources to a more focused, coordinated and integrated goal of the CCRI, namely to produce first science then observations, then lastly, some public policy making tools that will enable us to meet the goal of managing this problem more effectively in the future. We also will be continuing to fund the—those portions of the GCRP that will have payoffs in future years. Total CCRI funding would increase from $40 million to over $180 million, as has been mentioned by Dr. Marburger.

Turning now to TA and to NIST, we request $505 million for TA, including $8 million for the Office of Technology Policy and $497 million for NIST. For more than a century, NIST has conducted world-class measurement and standards research to enhance our nation's productivity and improve our quality of life. And they have done it very well.

Of the NIST request, $382 million is for the laboratory programs. While on paper, this appears to be a decrease of some $2 million, it is actually an increase of $33 million for the core NIST research efforts, because last year's request included a one-time funding for the equipment for the Advanced Measurement Laboratory, the construction of which is being completed this fiscal year. Among other things, this request will allow NIST to apply lessons learned from the investigation of the World Trade Center collapse, to develop im-

proved building codes, and to make building occupants and emergency responders safety—safer than they have been.

As I mentioned at the start, we have had to make some tough choices. Consistent with the President's emphasis on high-priority programs, this request focuses on NIST's core mission efforts rather than on its extramural programs. The Advanced Technology Program and the Manufacturing Extension Program both fall outside, in my view, of the core mission of this department. While these programs have been shown to be effective, and there are many supporters of them, we believe that the investment of our limited resources in the laboratory programs that we have and that we are responsible for will have the greatest impact on fostering innovation and economic growth in our country.

I would also like to mention that we are in the process of developing a plan to enhance the effectiveness of the Department's contribution to the reinvigoration of America's high-tech industries. The convergence of technology and telecommunications is a reality in today's global economy. Recognizing this and in order to best coordinate the Department's efforts on behalf of these important industries, we are working on a proposal to bring the National Telecommunications and Information Administration, NTIA, and the e-commerce policy functions of our International Trade Administration, ITA, into the Technology Administration so that we would have a single—be able to speak with a single voice.

We noted these changes will require Congressional approval and we look forward to working with you and your staff as we move forward with the development of the specifics of this modernization program.

[The prepared statement of Dr. Bodman follows:]

PREPARED STATEMENT OF DEPUTY SECRETARY SAMUEL W. BODMAN

In his remarks at the presentation last summer of the National Medals of Science and National Medals of Technology, President Bush reaffirmed this Administration's commitment to science and technology by stating:

> We'll continue to support science and technology because innovation makes America stronger. . .. Innovation helps our economy grow, and helps people find work. Innovation strengthens our national defense and our homeland security. . ..

Therefore, Chairman Boehlert, Ranking Member Hall, and Members of the Committee, it gives me great pleasure to have this opportunity to testify on the President's Fiscal Year (FY) 2004 Budget request for science and technology programs within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and Technology Administration (TA). I am pleased to share with you the Department's budget priorities for the upcoming fiscal year.

The FY 2004 President's Budget request for NOAA is $3.326 billion in total discretionary budget authority. The FY 2004 President's Budget request for TA is $504.8 million in total discretionary budget authority, which includes $496.8 million for the National Institute of Standards and Technology (NIST). The Department's entire budget request of $5.4 billion supports the President's budget plan to focus resources on several core services, including:

- fostering the Nation's economic growth;
- securing our homeland and enhancing public safety;
- upgrading the Department's facilities, infrastructure, and safety; and
- implementing the Administration's Climate Change Research Initiative to reduce present uncertainties in climate science so that we may make more knowledgeable policy decisions.

To enhance these services, resources have been shifted from various lower priority programs. I have spent much of the past year listening to leaders in technology industries describe the ways the Federal Government can better foster innovation in the private sector. Secretary Evans and I also have been consulting closely with leaders of other federal science and technology agencies to ensure the Department's resources are directed to the areas where we can have the biggest impact and best coordination to meet national needs. The Administration has made tough choices. However, the Department has an ambitious agenda to use our science and technology resources, and I will specifically highlight the priorities that involve NOAA and TA.

But before I do that, I would be remiss if I did not acknowledge the terrible and tragic loss of the shuttle Columbia and its crew just 12 days ago. The seven astronauts who perished aboard the shuttle were courageous and brilliant men and women dedicated to forever pushing back the boundaries of our scientific understanding. I should point out that NASA and NOAA have a long history as partners in the development of our environmental satellite systems. As part of our routine support to the NASA shuttle program and satellite launches, NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) and National Weather Service (NWS) provide specialized services, including space-based observations and weather forecasts. In addition, NOAA's NWS transmitted emergency broadcasts in Texas and Louisiana via the NOAA Weather Radio. NOAA will continue to provide high resolution weather data and satellite services as needed for the Columbia shuttle investigation.

Fostering Economic Growth. Economic growth is a central theme for the FY 2004 President's Budget. The Administration firmly believes that the Government's job is to remove obstacles that inhibit faster economic growth and innovation. President Bush is fond of saying that Government does not create wealth, people do—so, our job is to create the right environment for businesses to flourish and prosper. America leads the world in developing and commercializing new ideas. This is critical to our economic security, national security and homeland security. To continue the Nation's leadership in science and technology in the 21st Century, the Administration is requesting funding for NIST to support economic growth by enhancing programs, such as those involving nanotechnology, quantum computing, and health care quality assurance. In addition, the Administration's FY 2004 request supports NOAA's efforts to promote economic growth by improving the efficiency of maritime shipping and through developing forecast products that can be used to support economic decisions.

Homeland Security. The Administration is, of course, committed to protecting the Nation. We have a responsibility to protect our country from great dangers and to provide all Americans with a safe and secure place to live. Our strong national science and technology base is a key to homeland security and a crucial advantage in the war on terrorism. To contribute to this goal, the Department requests funding for NIST to provide the measurements and standards infrastructure necessary to provide for homeland security. The resources will fund the development and dissemination of standards for safety and security of buildings, for biometric identification systems, and for radiation detection systems and radiation-based security systems. The homeland security budget request for NOAA supports upgrading the NOAA weather radio operation to an All Hazards Warning Network, as well as the improvement of physical security at 149 NWS facilities.

Facilities, Infrastructure, Safety, and Human Capital. As I expressed last year when I testified before this committee, Secretary Evans and I consider the safety and security of Commerce Department employees—around the country and around the world—to be one of our most important responsibilities. The Department will focus on safety issues by instituting a new Occupational Safety and Health Program targeted toward preventing accidents and injuries through incident tracking and proactive prevention. It is essential that the Department's 37,000 employees work in a safe environment.

To protect critical research data from degradation, and to maintain employee safety and security, the Department is focusing substantial resources to upgrade NOAA and NIST facilities and laboratories. The budget proposes funding for NIST to address inefficiencies and safety problems at its facilities in Boulder, Colorado and Gaithersburg, Maryland. Valuable research continues to be lost or interrupted by power outages, spikes, and fluctuation. The President's FY 2004 Budget also seeks amounts to equip, maintain, and operate NIST's Advanced Measurement Laboratory (AML), and to fund time-scale dissemination backup elements. I would like to thank the Committee members for your support of the AML, a measurement and research

facility like no other in the world, on time and on budget to be completed in December 2003.

The Administration's budget request also supports NOAA's current infrastructure requirements, health, safety, and security-related activities. This request for NOAA will support the upgrade of NWS facilities, ensure that ships and aircraft are available to support NOAA missions, and provide for workforce planning and employee training.

Climate Change. The Department's budget request also provides funding to support President Bush's multi-agency Climate Change Research Initiative (CCRI). In response to President Bush's challenge to address the scientific uncertainties in climate change and take steps to address the factors that contribute to climate change, NOAA is moving forward with a plan to focus and accelerate climate science research. The CCRI will target the study of scientific uncertainty, strengthen climate and ecosystem observations and monitoring, and provide substantive scientific information for policy and management decisions. Addressing global climate change with decisions based on sound science is a priority for the Department. Moreover, NOAA is leading the charge to develop an international system that will provide comprehensive and sustained global observation and reliable operational climate forecasts. In short, a global observation system will allow us to take the pulse of the planet. The Bush Administration is firmly committed to addressing the many issues surrounding climate change, and I will highlight several programs later in my testimony that reflect our efforts and priorities.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) PROGRAMS

NOAA plays a vital role in the everyday lives of our citizens through numerous contributions to the Nation's economy, homeland security, and environmental health. The President's FY 2004 Budget request for NOAA of $3.326 billion in total discretionary budget authority represents an increase[1] of $190.0 million, or six percent over the FY 2003 President's Request. The Department of Commerce proposes increased spending in the following areas of interest to this committee: Economic Growth ($7.7 million increase; $116.0 million total); Homeland Security ($7.7 million increase; $65.1 million total); Facilities, Infrastructure, Safety, and Human Capital ($79.5 million increase, including adjustments to base; $248.4 million total); Climate Change Research, Observations, and Services ($16.9 million increase; $295.9 million total); Ecosystem Forecasting and Management ($76.0 million increase; $1017.1 million total); and Environmental Monitoring and Prediction ($99.5 million increase; $1600.6 million total). I would like to highlight some of the major components of these priority funding areas. These programs are carried out by NOAA's National Weather Service (NWS), National Environmental Satellite, Data, and Information Service (NESDIS), and Office of Oceanic and Atmospheric Research (OAR).

The President's FY 2004 Budget request for NOAA provides essential support to programs that enhance our scientific understanding of the oceans and atmosphere in order to sustain America's economic vitality and environmental health. Funding included in the President's Budget request will allow NOAA to ensure that our vision for environmental stewardship and assessment and prediction of the Nation's resources becomes a reality and that NOAA will continue to excel in our science and services to the American people.

Fostering Economic Growth. The Administration's request for NOAA includes an increase of $7.7 million (for a total of $116.0 million) for improving the efficiency of maritime shipping and developing forecast products that can be used to support economic development decisions. This investment in enhanced forecasting capabilities has the potential to save energy consumers $30.0 million per day through the use of improved temperature forecasts for decision-making by energy producers, weather risk managers, and water resource managers. Ninety-five percent of America's non-NAFTA trade moves through the marine transportation system. Improved oceanographic forecast modeling capabilities will assure safe and efficient maritime transit in U.S. waterways and vessel approaches into the Nation's commercial ports, as well as increased efficiency in addressing hazardous material spills.

Homeland Security. Ensuring public safety remains a priority of the Department as well as of NOAA and its National Weather Service (NWS). The budget request for NOAA includes an increase of $7.7 million (for a total of $65.1 million) to en-

[1] As in the Department of Commerce Budget in Brief, references in this testimony to FY 2004 "increases" refer to changes from the base. Base is the combination of the President's FY 2003 Budget request and any adjustments to base.

hance homeland security. This increase includes new funding in the amount of $5.5 million to support a scaled upgrade of the current NOAA Weather Radio (NWR) operation to an All Hazards Warning Network. This upgrade includes systems to standardize and automate receipt and dissemination of non-weather emergency messages. The Administration is also requesting $2.2 million in new funding for emergency preparedness and safety to improve physical security at 149 NWS facilities in order to prevent unauthorized individuals from entering and/or tampering with NWS property.

Facilities, Infrastructure, Safety, and Human Capital. The Administration's budget request for NOAA supports an increase of $79.5 million (for a total of $248.4) for current infrastructure requirements, health, safety, and security-related activities. It ensures that ships and aircraft are available to support our missions, and provides for workforce planning and analysis, employee training and retooling. Specifically, the requested funds will support the application of resources to upgrade and maintain NOAA facilities and to provide a safe, productive environment for its valued employees, and also to target the current backlog of facilities projects. The President's FY 2004 Budget requests a $3.0 million increase to accelerate the construction of NWS's Weather Forecast Offices. This facility will be located primarily in Alaska and has a planned completion date during FY 2008. In addition, we are requesting $10.4 million for the construction of a new NOAA Science Center, which will house the existing National Center for Environmental Prediction, as well as other NOAA offices now located in Suitland, Maryland.

Climate Change. One of the highlights of the Department's FY 2004 Budget is the total request of $295.9 million for NOAA's climate change research, observations and services. This amount includes an increase of $16.9 million as part of a total request of $41.6 million for NOAA's contribution to the President's interagency Climate Change Research Initiative (CCRI). The NOAA FY 2004 CCRI request supports NOAA's efforts to:

- enhance ocean observations for climate;
- augment carbon-monitoring capabilities in North America as well as in key under-sampled oceanic and continental regions around the globe;
- advance the understanding of all major types of aerosols;
- establish a climate modeling center within NOAA's Geophysical Fluid Dynamics Laboratory, which will focus on research, analysis, and policy applications for the development of model product generation; and
- coordinate and manage the Nation's interagency climate and global change programs through the Climate Change Science Program Office.

The President's CCRI led to the creation of a new interagency framework in order to enhance coordination of federal agency resources and research activities. Under this framework, thirteen federal agencies are working together under the leadership of a Cabinet-level committee on climate change, headed by Secretary of Commerce Evans and Secretary of Energy Abraham, to improve the value of U.S. climate change research.

The President's FY 2004 Budget request for climate change activities reflects the President's priorities by focusing federal research on the elements of the U.S. Global Change Research Program (USGCRP) that can best support improved public discussion and decision-making. Under the CCRI, various agencies will adhere to specific performance goals, including providing products to decision-makers within four years. The priorities of the CCRI are:

- reducing key scientific uncertainties;
- designing and implementing a comprehensive global climate and ecosystem monitoring and data management system; and
- providing resources to support public evaluation of a wide range of climate change scenarios and response options.

Even in this time of difficult budget decisions, the President is committed to fully funding climate research so that we can continue to reduce the uncertainties associated with climate change.

Other NOAA Priorities. The Administration is requesting $76.0 million (for a total of $1,017.1 million) for the development and application of the necessary tools for managing marine ecosystems. Of particular interest to this committee is the increase of $2.0 million to study the effect of climate regimes on marine species. The research will improve the understanding and prediction of climate change in the Bering Sea and Gulf of Alaska and study the effects of climate change on North Pa-

cific coastal and marine ecosystems. The study will also help predict and mitigate social and economic effects of long-term climate change on fisheries-dependent coastal communities.

The Administration proposes an increase of $99.5 million (for a total of $1,600.6 million) for NOAA's environmental monitoring and prediction programs. This includes programs that are directed towards the collection of data to monitor the environment's climate and weather patterns. These resources also expand the use of data collection platforms (aircraft, observing systems, satellites) for improved weather predictions. The program increases will sustain current operations and expand existing services which are essential to maintaining forecast abilities and predicting severe weather. Following are elements of these total increases.

- The request includes $2.0 million in new funds for enhanced coastal global observations, and $3.6 million in new funds for maintaining the existing observational infrastructure at four stations in Micronesia to continue observations in the Pacific Region.
- Also requested is an increase of $3.7 million (for a total of $12.0 million) for NEXRAD technology infusion to accelerate the deployment of the NEXRAD Open Radar Data Acquisition and Dual Polarization. Infusion and acceleration of NEXRAD planned product improvement by one to two years will result in increased tornado detection accuracy from 68 to 75 percent and improve tornado warning lead time from 11 to 15 minutes by FY 2007.
- A request of $2.9 million in new funds will provide technology refreshment of the National Weather Service's telecommunications gateway. An addition of $1.3 million in new funds will sustain operations and maintenance of the Susquehanna River Basin Flood System enhanced flood prediction capabilities.
- A replacement Turbo Commander for conducting snow surveys is requested and priced at $1.5 million. Scheduled mid-life aircraft maintenance and other increases in aircraft upkeep requires an additional $1.6 million.
- New funds in the amount of $1.3 million are requested for the international atmospheric research program, The Observing System Research and Predictability Experiment (THORPEX).
- Finally, an increase of $81.7 million (for a total of $668.6 million) is requested for NOAA's major space-based observing platforms, the Geostationary Operational Environmental Satellites (GOES) and NOAA's Polar-orbiting Operational Environmental Satellites (POES) and the National Polar-orbiting Operational Environmental Satellite System (NPOESS).

TECHNOLOGY ADMINISTRATION (TA) PROGRAMS

TA is the focal point within Commerce for fostering the development of the technological infrastructure required to support U.S. industry through the 21st century. TA accomplishes this by:

- fostering the development, diffusion, and adoption of new technologies;
- disseminating information on U.S. and foreign technology strategies and best practices; and
- seeking to create a business environment conducive to innovation.

In support of the President's priorities for science, technology, and U.S. competitiveness, TA's Office of Technology Policy (OTP) is working on national policies and initiatives that use technology to build America's economic strength. OTP promotes innovation through advocating policies that encourage research, development, and commercialization of new technologies (such as nanotechnology and biotechnology). OTP chairs an interagency working group on federal technology transfer, which seeks to improve the government's technology commercialization practices and publishes annually the Secretary's report to Congress on all federal technology transfer efforts. As part of its emerging technology initiative, OTP also has co-sponsored and organized National Nanotechnology Conferences at MIT and Northwestern University. In addition, OTP has completed a report on fuel cell research. As the President stated in his State of the Union Address, fuel cell research plays an important role in American competitiveness and innovation leadership.

As part of the Department's contribution to national homeland security efforts, OTP has undertaken a "Critical Technology Assessment of Biotechnology in U.S. Industry." This assessment will provide information about national bio-defense capabilities and industry relationships with the Department of Defense, as well as a wealth of other information for policy makers who are interested in supporting this critical technology.

The FY 2004 President's Budget request for all of TA is $504.8 million in total discretionary budget authority, including $8.0 million for the Office of the Under Secretary for Technology/OTP and $496.8 million for NIST. This represents a decrease of $66.2 million, or 12 percent less than the FY 2003 President's Request. The NIST request includes funding in the following areas of interest to this committee: Economic Growth ($380.4 million); Homeland Security ($38.7 million); and Facilities and Infrastructure ($77.7 million).

THE PROGRAMS OF TA'S NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST carries out a key part of TA's mission, performing world-class research to develop and promote measurements, standards, and technology in order to enhance productivity, facilitate trade, and improve the quality of life.

For more than one hundred years, the Nation has relied upon NIST for scientific and technical expertise to promote economic growth, commerce and trade, and national security. The quality of NIST work is exemplified by the award of the world's ultimate recognition in science, the Nobel Prize, since 1997, to two NIST scientists—Bill Phillips in Gaithersburg, Maryland, and Eric Cornell in Boulder, Colorado. The work they are leading in super-cold matter and the strange nature of quantum mechanics is driving whole new areas of science and technology, from atomic clocks that do not gain or lose more than a billionth of a second in thirty years, to the potential for unimaginably powerful computers based on individual atoms, to new forms of telecommunications that provide the ultimate in information security.

NIST manages the Baldrige National Quality Program, the Nation's premier program to recognize and promote performance excellence and quality achievement in businesses and organizations. In 2002, SSM Health Care of St. Louis became the first Baldrige winner in the health care category, complementing the first three winners in the education category announced in 2001. These award winners will be excellent 21st century role models for other organizations working to promote quality health care at lower cost as well as educational organizations that prepare our young people to succeed. We are hopeful that the Baldrige Program will motivate the same kind of quality revolution in education and health care that it helped to launch in U.S. industry.

The President's FY 2004 Budget request for NIST focuses on homeland security, supporting economic growth, and building the laboratory infrastructure NIST needs to meet current and future technology demands. The President requests a total of $381.8 million for the NIST laboratory account, and $5.8 million for the Baldrige Program. In addition, $69.6 million is requested in the construction account for NIST facility upgrades. Finally, the President requests $27.0 million for the Advanced Technology Program and $12.6 million for the Manufacturing Extension Partnership program.

Fostering Economic Growth. The President's request for the NIST Laboratories includes an increase of $9.2 million (for a total of $340.8 million) to strengthen the national measurements and standards infrastructure that enables innovation and economic growth. The request will enable NIST to expand its work in the areas of nanotechnology, advanced information technology, and health care diagnostics—all areas with broad economic impact.

NIST will expand its program in nanotechnology, the so-called "tiny revolution" in technology, with a $5.2 million increase (for a total of $62.0 million). NIST is already a leader in this exceptionally promising area. Nearly all industrial sectors plan to exploit this emerging technology, and most of these plans call for appropriately scaled measurements and standards, NIST's specialty. NIST closely coordinates its nanotechnology work with other federal agencies through the President's National Nanotechnology Initiative, or NNI. NIST appropriately has the lead in providing the measurements and standards infrastructure for the NNI.

The request also includes an increase of $3.0 million (for a total of $7.3 million) to build on NIST's world-class expertise in quantum computing and communications. This effort, with teams led by NIST's two Nobel laureates, is developing revolutionary means of making calculations much more quickly than traditional electronic computers will ever be able to do. NIST scientists already have made the working elements of quantum computers based on individual atoms. NIST also will expand its work in using quantum properties to provide the ultimate security in telecommunications that are impossible to intercept without tipping off the people in the conversation.

The Administration also requests funding to allow NIST to strengthen its programs supporting health care diagnostics, which not only improve the quality of health care, but also ensure that U.S. manufacturers can fairly compete in the $20

billion global market for these products. The request includes an increase of $1.0 million (for a total of $17.1 million) to strengthen this effort.

Consistent with the President's emphasis on shifting resources to reflect changing national needs, the President's FY 2004 Budget proposes terminating the Advanced Technology Program (ATP) and requests a total of $27.0 million for administrative and close-out costs. The FY 2004 President's Budget also proposes maintaining the FY 2003 policy of significantly reducing federal funding for the Manufacturing Extension Partnership (MEP), for which the budget requests $12.6 million. These programs have been well-run and effective, but the scarce resources are needed for higher priority programs. The budget request focuses on NIST's core mission of measurements, standards, and laboratory research, rather than its extramural programs, by providing the 21st century facilities the NIST Laboratories need for success. Investment of limited NIST resources in the Laboratory programs and facilities will have the greatest impact on strengthening homeland security and fostering innovation that leads to economic growth.

Homeland Security. We request an increase of $10.3 million (for a total of $38.7 million) for NIST to address key national needs for homeland security measurements, standards, and technologies. This request will strengthen NIST's portfolio of more than 100 projects that address homeland security technology needs.

Included in this request is an increase of $4.0 million (for a total of $10.9 million) as part of a program to use lessons learned from the NIST-led investigation of the World Trade Center collapse to make buildings, occupants, and emergency responders safer from terrorist attacks on buildings and other building disasters. Thanks to the support of this committee, NIST is on track to complete the building and fire study of the World Trade Center disaster by the fall of 2004 as planned. We are already getting useful information from the investigation. The requested funds will help NIST, the private sector, and state and local agencies to learn more and to develop and disseminate guidance on building practices, building codes, occupant behavior, and emergency response to save lives and reduce property loss. The Committee has recognized that NIST has the unique combination of technical expertise in a broad range of building and fire sciences and lengthy experience working with the building and emergency responder communities to provide the Nation with the maximum benefit from the WTC investigation and associated research.

The NIST homeland security request also includes an increase of $5.3 million (for a total of $26.8 million) to develop the measurement infrastructure needed to detect nuclear and radiological ("dirty bomb") threats, to improve the use of radiation such as x-rays and other imaging techniques to detect concealed terrorist threats, and to safely and effectively use radiation to destroy biowarfare agents such as anthrax.

Our homeland security request also includes a total of $1 million to develop standards and test methods for biometric identification systems, used to positively identify the approximately 20 million non-citizens who enter the U.S. each year or apply for visas. This will enable NIST to carry out the mandate of the USA PATRIOT Act, which requires NIST to develop technology standards for biometric identification, recognizing NIST's long history of expertise in this area.

I want to emphasize that the President expects that the Nation will have a coordinated approach to homeland security that appropriately uses federal resources and fully recognizes the crucial role of the private sector in providing homeland security technologies. NIST has been working very closely with the Transition Planning Office of the Office of Homeland Security and agencies slated to join the new Department of Homeland Security to help develop the standards strategy for the Science and Technology mission of the new Department. Measurements and standards are key to enabling the development of new homeland security technologies by the private sector and federal laboratories, ensuring the technologies perform as expected, and enabling state and local governments and emergency response organizations to make informed decisions about purchasing and using homeland security technologies. NIST expects to play a key role in providing the measurements and standards infrastructure for homeland security. NIST has more than 100 years of experience working with the private sector on measurements and standards issues.

Facilities, Infrastructure, and Safety. We are requesting an increase of $43.3 million (for a total of $77.7 million) for facilities, infrastructure, and safety projects to help ensure that the NIST laboratories are adequate to deliver on our promises. The request includes an increase of $21.3 million (for a total of $33.1 million) for long-overdue improvements at NIST's laboratories at Boulder, Colorado, where most of the buildings are nearly 50 years old. Obsolescence already threatens the ability of the Boulder staff to provide services that meet the levels of accuracy required by their industrial customers. The list of improvements to be made is long, but we intend to make a serious start on improving those facilities.

The facilities, infrastructure, and safety request also includes an increase of $10.6 million (for a total of $33.1 million) for maintenance, repair, and safety improvements at both the Boulder, Colorado, and Gaithersburg, Maryland campuses. Even with facilities improvements initiated in Boulder and completion of the AML, most NIST laboratory facilities are 35 to 50 years old, and the maintenance and safety requirements grow each year. NIST also requests a total of $3.4 million in new funding to design the future renovations of NIST Gaithersburg Building 220.

Finally, the Administration requests a total of $6.7 million for equipment and maintenance of the AML, to ensure that the Nation's investment in this unique facility can be fully used. We also request a total of $1.4 million to ensure that the National time scale maintained by NIST is secure and backed up against possible failure or attack. The NIST national time scale is used several hundred million times each day to ensure that time-keeping devices of all kinds are accurate. Federal regulations require that certain electronic financial transactions be time-stamped using NIST time, and electric power grid switching, navigation and communications are among the other activities highly dependent on this service from NIST.

This committee has been a strong advocate of ensuring that NIST has the facilities and physical infrastructure needed to do the job. We appreciate your long-standing support, and we will continue to demonstrate to you that investment in NIST returns great benefits to the Nation.

CONCLUSION

This completes my statement. The Department has many exciting technology initiatives. I look forward to working with you as these proposals move through the legislative process. I would be pleased to answer any questions you may have.

BIOGRAPHY FOR SAMUEL W. BODMAN

Samuel W. Bodman is the Deputy Secretary of the Department of Commerce. A financier and executive by trade, he is well suited to his role of managing the day-to-day operations of the cabinet agency with 40,000 employees and a $5 billion budget. An engineer by training, he is well qualified for his specific oversight focus on the National Oceanic and Atmospheric Administration, the Patent and Trademark Office, and the National Institute of Standards and Technology.

With 31 years' experience in the private sector, Deputy Secretary Bodman is a firm believer in the American free enterprise system. His work in the finance industry began when he was professor at the Massachusetts Institute of Technology (M.I.T.) and started consulting with the venture capital sector. He and his partners and associates provided financial and managerial support to scores of new business enterprises located throughout the United States. Virtually all of these companies had strong dependence on technology and innovation. Many of these achieved great financial success and established public markets for their securities.

Born in 1938 in Chicago, he graduated in 1961 with a B.S. in chemical engineering from Cornell University. In 1965, he completed his ScD at Massachusetts Institute of Technology. For the next six years he served as an Associate Professor of Chemical Engineering at MIT and as Technical Director of the American Research and Development Corporation, a pioneer venture capital firm.

From there, Deputy Secretary Bodman went to Fidelity Venture Associates, a division of the Fidelity Investments. In 1983 he was named President and Chief Operating Officer of Fidelity Investments and a Director of the Fidelity Group of Mutual Funds. In 1988, he joined Cabot Corporation, a Boston-based Fortune 300 company with global business activities in specialty chemicals and materials, where he served as Chairman, CEO, and a Director. Over the years, he has been a Director of many other publicly owned corporations.

Deputy Secretary Bodman has also been active in public service. He is a former Director of M.I.T.'s School of Engineering Practice and a former member of the M.I.T. Commission on Education. He also served as a member of the Executive and Investment Committees at M.I.T., a member of the American Academy of Arts & Sciences, and a Trustee of the Isabella Stewart Gardner Museum and the New England Aquarium.

Deputy Secretary Bodman is married to M. Diane Bodman. He has three children, two stepchildren, and seven grandchildren. He and his wife reside in Washington, D.C.

Chairman BOEHLERT. Thank you very much. Dr. Colwell.

STATEMENT OF DR. RITA R. COLWELL, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. COLWELL. Chairman Boehlert, members of the Committee, I am very pleased to be here before you today, and I ask that my written testimony in a summary of the NSF budget request be included in the record.

Before I begin, I would like to show a very brief video. You, of course, Mr. Chairman, will be familiar with what is shown, but for the benefit of those who couldn't visit the Antarctic research site, it is an opportunity to see how effectively NSF manages its research facilities and programs.

[Video]

The NSF's investments are aimed at the frontiers of science and engineering research and education where advances in fundamental knowledge drive innovation and progress. The NSF budget proposal for fiscal year 2004 leaves no doubt that the President embraces our conviction that the surest way to keep our nation prosperous and secure in the 21st Century is to keep it at the forefront of learning and discovery.

This year, the National Science Foundation is requesting $5.48 billion, $453 million or nine percent more than last year's request. And again, I point out as the other previous speakers have done, that we were working from the President's 2003 budget.

Before providing just a few highlights, let me stress that our priorities are determined in continuous consultation with the research and education community. The programs are initiated, enlarged, or terminated based on intellectual merit, broader impacts, importance to science and engineering and education, balance and coordination across fields, and synergy with other agencies and nations. NSF interacts with our sister research agencies both informally through our actively informed program officers and formally through the interagency review panels and agreements. Moreover, our Committee of Visitors process provides constant evaluation and feedback about how the NSF programs are performing. And they do perform well.

NSF puts its money where it counts. Ninety-five percent of our budget goes directly to research and education that keep our knowledge base active, our economy humming, and benefits to society flowing. Our highest priority is maintaining the quality of U.S. science and engineering. The fiscal year 2004 budget includes $200 million for the Math and Science Partnership Program, which is the centerpiece of the President's No Child Left Behind Initiative. To attract more of the promising students to graduate studies, NSF proposes to raise the annual stipends for graduate fellows to $30,000 and, more importantly, to increase the number of fellowships.

We have budgeted $7 million to our Tech Talent Program, which represents a 250 percent increase over fiscal year 2003, $4 million for the Noyce Scholarship Program, and $16.2 million for the Cybercore Program, which represents a 45 percent increase over last year's requested level.

In addition, $8.5 million will fund the development of a 21st Century work force focus to attract U.S. students to science and engineering fields and to broaden participation. There will be an addi-

tional investment of $20 million to fund three new science of learning centers to investigate how people learn, capitalizing on recent progress in cognitive science, neuroscience, and information technology. We are also proposing a 12.7 percent increase in funding for the physical sciences, which I am truly delighted. It will provide over $1 billion to sustain the vigorous research in the math and physical sciences that has helped power advances in medicine, energy, agriculture, and understanding the environment.

Now the budget includes funding for six priority areas. As the lead agency in two of the Administration's top interagency R&D efforts, NSF has budgeted $303 million for information technology research, $249 million in the National Nanotechnology Initiative, and an additional $100 million for biocomplexity in the environment to support microbial genome sequencing and the ecology of infectious diseases, which are areas of vital importance to anti-terrorism efforts.

An $89 million investment will be made in mathematical sciences to improve our ability to handle the massive data sets produced by today's sensors and observation systems and to model and manage uncertainty. Building on previous investments in the social, behavioral, and economic sciences, we are requesting $24 million to launch a human and social dynamics priority area that will investigate the impacts of change on our lives and the stability of our institutions, including the effects of globalization and the way people take risks and make decisions.

The largest dollar increase in NSF's fiscal year 2004 budget is in tools. The total of $1.3 billion includes an additional $219 million to meet the growing needs for small and midsized projects as well as major facilities. The budget also provides a prioritized list of all the major research equipment and facilities construction projects that have been approved by the National Science Board.

Therefore, I ask for your support for our fiscal year 2004 budget request. And I really would like you to know how much the Foundation appreciates the Committee's long-standing, bipartisan support. Mr. Chairman, I will be very happy to answer any questions that you may have. Thank you.

[The prepared statement of Dr. Colwell follows:]

PREPARED STATEMENT OF RITA R. COLWELL

Chairman Boehlert, Members of the Committee, I am pleased to appear before you today. For more than fifty years, the National Science Foundation (NSF) has been a strong steward of America's science and engineering enterprise. Although NSF represents less than four percent of the total federal budget for research and development, it accounts for one-fifth of all federal support for basic research and 40 percent of support for research at academic institutions, excluding the life sciences. Despite its small size, NSF has an extraordinary impact on scientific and engineering knowledge and capacity.

During NSF's five decades of leadership, groundbreaking advances in knowledge have reshaped society and enabled the United States to become the most productive nation in history. The returns on NSF's strategic investments in science, engineering, and mathematics research and education have been enormous. Much of the sustained economic prosperity America has enjoyed over the past decade is the result of technological innovation—innovation made possible, in large part, by NSF support.

In our 21st century world, knowledge is the currency of everyday life, and at the National Science Foundation we are in the knowledge business. Our investments are aimed at the frontiers of science and engineering research and education, where advances in fundamental knowledge drive innovation and progress.

Today, our nation faces significant challenges—in security, health, the economy, and the workforce. The surest way to keep our nation prosperous and secure is to keep it at the forefront of learning and discovery. The NSF budget proposal for FY 2004 aims to do just that, and I am very pleased to present it to you today.

I'll begin with the big picture. This year the National Science Foundation is requesting $5.48 billion dollars. That's an additional $453 million, or nine percent more than last year's request.

This budget leaves no doubt that the President embraces NSF's vision and value. NSF-funded research and education will help us meet the economic and national security challenges facing us at home and abroad, now and in the future.

NSF has been growing—surely and steadily. Our investments this year put us on the right path, and with the leadership and vision of this committee, the NSF Authorization Act, signed by the President in December, will keep us moving in the right direction in the years to come.

To promote the progress of science, NSF invests in three strategic areas.

People: Facilitating the creation of a diverse, internationally competitive, and globally engaged workforce of scientists and engineers and well-prepared citizens is NSF's first priority. To achieve this goal, NSF supports improvement efforts in formal and informal science, mathematics, engineering, and technology education. Across its science, mathematics, engineering, and technology research and education programs, NSF works to enhance the diversity of our science and engineering workforce. The Foundation provides support for almost 200,000 people, including students, teachers, researchers, post-doctorates, and trainees.

Ideas: Investments in ideas support cutting edge research and education that yield new and important discoveries and promote the development of new knowledge and techniques within and across traditional boundaries. These investments help maintain America's academic institutions at the forefront of science and engineering. The results of NSF-funded projects provide a rich foundation for broad and useful applications of knowledge and development of new technologies. Support for ideas also promotes the education and training of the next generation of scientists and engineers.

Tools: NSF investments provide state-of-the-art tools for research and education, including instrumentation and equipment, multi-user facilities, digital libraries, research resources, accelerators, telescopes, research vessels and aircraft, and earthquake simulators. These tools also include large surveys and databases as well as computation and computing infrastructure for all fields of science, engineering, and education. Support for these unique national facilities is essential to advancing U.S. research and education.

Of course, People, Ideas and Tools work together to give us the best returns in discovery, learning and innovation.

Before providing a few highlights of the budget, let me stress that the priority-setting process at NSF results from continual consultation with the research community. New programs are added or enhanced only after seeking the combined expertise and experience of the science and engineering community, the Director and Deputy, and the National Science Board.

Programs are initiated or enlarged based on considerations of their intellectual merit, broader impacts of the research, the importance to science and engineering, balance across fields and disciplines, and synergy with research in other agencies and nations. NSF coordinates its research with our sister research agencies both informally—by program officers being actively informed of other agencies' programs—and formally, through interagency agreements that spell out the various agency roles in research activities. Moreover, through our Committee of Visitors process there is continuous evaluation and feedback of information about how NSF programs are performing.

Producing the finest scientists and engineers in the world and encouraging new ideas to strengthen U.S. leadership across the frontiers of discovery are NSF's principal goals. NSF puts its money where it counts—95 percent of our budget goes directly to the research and education that keep our knowledge base fresh, our economy humming and the benefits to society flowing.

Each year, NSF funds about 33,000 proposals at the leading edge of research. And we support more than 200,000 students, teachers, and researchers.

Investing in People is key to developing the Nation's full talent and maintaining the quality of our workforce. There is no better place to begin than with our children. We must ensure that every child can participate in the Nation's prosperity and contribute to its progress.

The budget includes $200 million for the Math and Science Partnership program, a key component of the President's *No Child Left Behind* initiative. This is the third installment of a $1 billion, five-year investment to raise the performance of all U.S. students in mathematics and science. The program links local schools with colleges and universities to improve teacher performance and provide a challenging curriculum for every student. And it creates innovative ways to reach out to underserved students and schools.

Our nation's science and engineering workforce is the most productive in the world. To keep it that way, we have to attract more of the most promising students to graduate-level studies in science and engineering.

We have been steadily increasing stipend levels from a low of $15,000 in 1999, and it's working. Applications for graduate fellowships increased by 19 percent between 2001 and 2002. This year, we are requesting an increase to $30,000. And, we will also increase the number of fellowships.

Opportunities to advance knowledge have never been greater than they are today. NSF invests in emerging areas of research that hold exceptional potential to strengthen U.S. world leadership in areas of global economic and social importance. This year, we are requesting funding for six of these priority areas: biocomplexity, information technology, nanoscale science and engineering, mathematical sciences, human and social dynamics, and the 21st century workforce.

The budget includes a $100 million dollar request for research in Biocomplexity in the Environment. This investment will continue support for microbial genome sequencing and the ecology of infectious diseases, two areas that are of vital importance to the Nation's anti-terrorism efforts. Research that charts the interactions among physical, human, and other living systems, will improve our ability to understand and manage our environment. The development of new technologies and tools rounds out this investment.

As the lead agency in two of the Administration's top interagency R&D efforts, NSF has provided an investment of $724 million in Networking and Information Technology Research and Development and $249 million in the National Nanotechnology Initiative.

Our priority area investment in Information Technology Research of $303 million will advance every field of science and add to our economic prospects. We propose to expand fundamental research in high-end computation and large-scale networking. Other investments address the need for safe and dependable information systems for national security and consumer protection. To reap the educational benefits of the information revolution, we plan to focus on the use of cutting-edge IT research in the classroom.

The emerging field of nanoscale science and engineering promises a revolution at least as far-reaching as the one we've witnessed in information, computer and communications technologies. The ability to manipulate and control matter at the atomic and molecular levels will open new possibilities in materials and manufacturing, medicine, environment and energy, and national security. As the lead agency in the National Nanotechnology Initiative, NSF is requesting $249 million to expand basic research on new materials, biological systems at the nanoscale, and quantum computing. We will address the need to build capacity through investments in centers, training programs, and equipment. Research on the social and educational impacts of nanotechnology can prepare us to make the best use of new applications.

Mathematics is the *lingua franca,* or as I like to say, the Esperanto of science and engineering. It leads us to new and deeper insights in every discipline. We propose to invest $90 million in the Mathematical Sciences priority area to pursue fundamental research in the mathematical sciences and statistics, and programs that will bring cutting-edge mathematical and statistical techniques to all fields.

This investment will improve our ability to handle the massive data sets produced by today's sensors and observation systems, and to model and manage uncertainty. We also propose to strengthen connections between research and education in the mathematical sciences.

Building on previous investments in the social, behavioral, and economic sciences, NSF proposes to launch a Human and Social Dynamics priority area. An investment of $24 million will fund research and new techniques to deepen our understanding of the impacts of change on our lives and on our institutions. The request will help us build the large-scale databases and refined research methods needed for major progress in the social sciences.

Research will improve our understanding of how people make decisions, take risks, and deal with uncertainty. We will also support studies of large-scale change, such as globalization, the evolution of society and its interaction with the environment, and the implications of culture for conflict and assimilation.

The Nation needs both world-class scientists and engineers, and a workforce that has the scientific and technical skills needed to thrive in today's changing workplace.

NSF is requesting $8.5 million to begin the development of a Workforce for the 21st Century priority area to address three critical national science and engineering workforce needs: preparing scientists and engineers capable of meeting the challenges of the 21st century; attracting more U.S. students to science and engineering fields; and broadening participation in science and engineering. We will fund Integrative Institutional Collaborations that bring together and integrate NSF educational activities that work—the Louis Stokes Alliances for Minority Participation (LSAMP) program, Graduate Teaching Fellowships in K–12 Education (GK–12), the Integrative Graduate Education Research Traineeships (IGERT) program, Research Experiences for Undergraduates (REU), and Centers of Research Excellence in Science and Technology (CREST) program, for example.

We will expand research opportunities for students and faculty from high schools and from 2-year and 4-year colleges. Our investments will emphasize efforts to build stronger links between research and education at historically black colleges and universities and minority-serving institutions.

Every year it becomes more difficult to choose only a few NSF activities to highlight in the budget presentation. But they are all genuinely significant, and I want to make brief comments about each.

Our nation is facing new and difficult challenges in homeland security. The NSF budget includes investments that will help us meet growing security needs. I've already mentioned programs in microbial genome sequencing and the ecology of infectious diseases. The Scholarships for Service program will train students in information security and assurance, in exchange for service in Federal Government agencies. Vital research in the Critical Infrastructure Protection program is designed to pinpoint vulnerabilities and strengthen protection for the Nation's power grids, transportation networks, and water supply systems. A diverse portfolio of security-related information technology research rounds out the NSF contribution. Every one of these investments will have a big payoff.

This year, the NSF budget places special emphasis on investments in the physical sciences. We propose a 12.7 percent increase that will bring total funding in areas such as physics, chemistry, mathematics, and materials research to over $1 billion dollars. We need this investment to spur the fresh and vigorous research in these fields that has helped in the past to power advances in medicine, energy, agriculture, and the environment.

As part of the President's multi-agency Climate Change Research Initiative, NSF will support focused research to reduce uncertainty in critical areas of climate change knowledge and provide timely information for policy decisions. We are requesting $4.5 million to establish three or more new centers to improve understanding of risk management, risk communication, and decision-making. These studies will complement NSF's ongoing programs in climate change science.

We know that diversity gives strength to the fabric of our society. The NSF request places special emphasis on broadening participation in science and engineering. The Historically Black Colleges and Universities (HBCU) Undergraduate Program increases by 43 percent, the Louis Stokes Alliance for Minority Participation, which helps minorities toward undergraduate degrees in science and engineering, and the ADVANCE program, aimed at more diversity among successful scientists with family responsibilities, will both increase by 23 percent, and finally, the Partnerships for Innovation program, which transfers knowledge from research and education into the creation of new wealth by strengthening local and regional economies, will double its budget to $10 million.

We are requesting $105 million for the EPSCoR program to continue building the capacity of educational institutions so that they can participate more fully in NSF research activities.

The Noyce Scholarships address the shortage of highly trained K–12 teachers by providing scholarships to talented mathematics, science, and engineering students who wish to pursue teaching careers in elementary or secondary schools.

This year, our budget provides $75 million to support ongoing research on the genomics of plants of major economic importance. This includes a program of Young Investigator Awards in Plant Genome Research.

The Science, Technology, Engineering and Mathematics Talent Expansion Program, or STEP, provides grants to colleges and universities to establish programs to increase the number of undergraduate math and science majors. We are requesting $7 million for the program this year, an increase of $5 million, or 250 percent, over the request for FY 2003.

The National Science Foundation furthers its research efforts by entering into partnerships with other federal agencies and regards these partnerships as a core strategy for enabling Foundation activities. As part of the Administration's multi-agency Climate Change Research Initiative, NSF will support research to reduce uncertainty in critical areas of climate change knowledge and provide timely information to facilitate policy decisions. The total FY 2004 investment for CCRI increases by $10.0 million to a total of $25.0 million.

Finally, the budget provides $20 million to fund three or more new Science of Learning Centers. These centers will build on advances in the social sciences, computer science, engineering, and neuroscience to investigate how people learn, how the brain stores information, and how best to use information technology to promote learning. The aim is to bring fresh knowledge to the design of learning environments.

The most significant dollar increase in NSF's FY'04 budget is in Tools, with a total investment of $1.34 billion, a $219 million increase over last year's request. Rapidly changing technology and increasing demand for state-of-the-art tools have put tremendous strain on the Nation's laboratories and research facilities. We need to renew our science and engineering infrastructure across the board, large and small. For the first time, in order to help Congress better understand our future planning needs, our budget provides a prioritization of all ongoing and planned major facility construction approved by the National Science Board.

NSF plans to invest in major research equipment and facilities construction projects over the next several years. One new start, ocean drilling, is planned for FY'05, with two new starts, Rare Symmetry Violating Processes (RSVP) and Ocean Observatories, for FY'06.

I want to emphasize that the $220 million increase in Tools is distributed across *all* of NSF's programs. It includes a new $20 million Cyber Infrastructure investment to bring next-generation computer and networking capabilities to researchers and educators nationwide. Other investments, in mid-sized and small equipment, for example, also receive a healthy portion of the increase.

In making these critical investments, NSF continues to put a very strong emphasis on effective and efficient management. We are proud of our track record.

Mr. Chairman and Members of the Committee, I hope that this brief overview conveys to you the extent of NSF's commitment to advancing science and technology in the national interest.

I ask not only for your support for our FY 2004 budget request, but also want you to know how much I appreciate the long-standing bipartisan support of the Committee for NSF. Mr. Chairman, I would ask to include a copy of NSF's budget summary as part of my testimony, and would be happy to answer any questions that you have.

BIOGRAPHY FOR RITA ROSSI COLWELL

Dr. Rita R. Colwell became the 11th Director of the National Science Foundation on August 4, 1998. Since taking office, Dr. Colwell has spearheaded the agency's emphases in K–12 science and mathematics education, graduate science and engineering education/training and the increased participation of women and minorities in science and engineering.

Her policy approach has enabled the agency to strengthen its core activities, as well as establish support for major initiatives, including Nanotechnology, Biocomplexity, Information Technology, Social, Behavioral and Economic Sciences and the 21st Century Workforce. In her capacity as NSF Director, she serves as Co-chair of the Committee on Science of the National Science and Technology Council.

Before coming to NSF, Dr. Colwell was President of the University of Maryland Biotechnology Institute, 1991–1998, and she remains Professor of Microbiology and Biotechnology (on leave) at the University Maryland. She was also a member of the National Science Board (NSF's governing body) from 1984 to 1990.

Dr. Colwell has held many advisory positions in the U.S. Government, non-profit science policy organizations, and private foundations, as well as in the international scientific research community. She is a nationally respected scientist and educator, and has authored or co-authored 16 books and more than 600 scientific publications. She produced the award-winning film, *Invisible Seas,* and has served on editorial boards of numerous scientific journals.

She is the recipient of numerous awards, including the Medal of Distinction from Columbia University, the Gold Medal of Charles University, Prague, and the University of California, Los Angeles, and the Alumna Summa Laude Dignata from the University of Washington, Seattle.

Dr. Colwell has also been awarded 26 honorary degrees from institutions of higher education, including her Alma Mater, Purdue University. Dr. Colwell is an honorary member of the microbiological societies of the UK, France, Israel, Bangladesh, and the U.S. and has held several honorary professorships, including the University of Queensland, Australia. A geological site in Antarctica, Colwell Massif, has been named in recognition of her work in the polar regions.

Dr. Colwell has previously served as Chairman of the Board of Governors of the American Academy of Microbiology and also as President of the American Association for the Advancement of Science, the Washington Academy of Sciences, the American Society for Microbiology, the Sigma Xi National Science Honorary Society, and the International Union of Microbiological Societies. Dr. Colwell is a member of the National Academy of Sciences.

Born in Beverly, Massachusetts, Dr. Colwell holds a B.S. in Bacteriology and an M.S. in Genetics, from Purdue University, and a Ph.D. in Oceanography from the University of Washington.

Chairman BOEHLERT. Thank you, Dr. Colwell. Mr. Card.

STATEMENT OF MR. ROBERT G. CARD, UNDER SECRETARY FOR ENERGY, SCIENCE, AND ENVIRONMENT, U.S. DEPARTMENT OF ENERGY

Mr. CARD. Thank you, Mr. Chairman, Members of the Committee. It is a pleasure to be here. I should have brought videos of our Methane Hydrates Program in the north that way we could have touched on both ends of the Earth today.

I am—rather than go through a list of numbers, I am just going to point out what were the strategic—what was the strategic thinking behind DOE's budget. As you probably know, there are eight assistant secretary level functions in the Department of Energy that provide significant R&D funding, and so I am going to talk about the items that were—there were key shifts in our strategy or thinking for the fiscal year 2004 budget.

First, in a nutshell, DOE's energy strategies generation of carbon-free electricity in Hydrogen. This is supported by expansions of two important initiatives. The first is President Bush's Hydrogen Initiative including FreedomCAR announced last year, which is now paired with the Hydrogen Fuel Initiative proposed for this year. This initiative is integrated with Hydrogen programs—new Hydrogen programs and nuclear and fossil energy, a renewed commitment to fusion power, and continued support of other energy sources for and basic research supporting Hydrogen electricity production. Secondly, supporting this strategy is an expanded carbon sequestration initiative. I might add that while FreedomCAR and fuel is focused on transportation, implementing this technology at the production scale required for vehicles could support breakthroughs in solar power systems, distributive, generation, and other energy programs.

The second area I will highlight is DOE's most significant internal environmental challenge, which is the management of spent nuclear fuel and high-level waste. To this end, we have integrated three programs with a continued science program to maximize our ability to safely, rapidly, and economically manage this material. These three programs include the Environmental Management Accelerated Cleanup Program, the Nuclear Energy Fuel Cycle Programs, and the Yucca Mountain Repository Program.

Thirdly, we want to draw your attention to a strong basic science research program with growing emphasis on nanotechnology, computation, and genomics, which underpins both priority programs

previously discussed and the remaining departmental initiatives. And lastly, to support these initiatives, the Department has aggressively implemented the President's Management Agenda with a number of activities, including, for example, organizational improvements in most each of those eight assistant secretary organizations to reduce layers of management and increase focus, streamlining requirements that don't add commensurate taxpayer value; more intensive project oversight; improvement of program evaluation criteria to guide research allocation decisions; and improved E-government programs. Again, we are grateful for the Committee's support of DOE's R&D program and look forward to your questions and comments.

[The prepared statement of Mr. Card follows:]

PREPARED STATEMENT OF ROBERT G. CARD

Introduction

Mr. Chairman, Members of the Committee, it is a pleasure to join you today to present details on the Department of Energy's FY 2004 budget submission. The Department appreciates the support of the Chairman and the Members of the Committee over the past years and I look forward to working with you to ensure this nation stays at the leading edge in science and technology in the 21st Century.

As Secretary Abraham noted recently, the Department has an "an ambitious, long-term vision of a zero-emissions future free of reliance on imported energy." As we look to the carbon free generation of electricity and hydrogen, it is clear that there is but one path open to us. We must call upon science, technology, and the research talents in our national laboratories, universities, and industry to help us improve and move beyond today's energy choices.

This year's budget demonstrates that the Department takes its responsibilities toward science and technology seriously because we take our responsibility toward national security seriously. Secretary Abraham has made clear that all missions at our Department flow from our core mission to support national security. We have, therefore, taken a deliberate and integrated approach to our research and development portfolio, using the strengths of all our programs to address this central mission. Clearly, environmental security and economic security underpin national security and each is sustained by science.

What is more, there is only one way to build an integrated budget and that is to engage in a vigorous and disciplined planning process that forces programs to set priorities. I think we have done that in this budget submission.

Mr. Chairman, consider how key initiatives undertaken in the FY 2004 budget are mutually supportive of the Department's overarching mission and reflect the need to set priorities:

- The President's Hydrogen Fuel Initiative—a major effort toward zero emissions and energy independence—looks toward critical research and development efforts to develop fuel cell technology, and to find ways to produce and distribute hydrogen.
- Our request for carbon sequestration, a critical effort in our climate change program, is forty percent greater than last year. Here too, we look to science and technology, some of it extraordinarily exciting, to help us address a host of concerns.
- This year's request represents a major restructuring of our technology programs focused on the nuclear fuel cycle. With our Advanced Fuel Cycle Initiative the Secretary is challenging our department's best scientists to help devise a new approach to establishing a safe, sustainable, and proliferation resistant future for nuclear energy. Our nuclear programs are also integrated across DOE R&D portfolio, including improving the repository at Yucca Mountain, and will support our hydrogen fuels initiatives.
- We are also committed to leapfrogging today's energy choices with advanced concepts such as fusion. The President has announced that we will enter negotiations on ITER, to explore the next critical step in bringing electricity from fusion energy to the grid. If fusion proves successful, it could be the dominant new energy source for the end of this century and beyond.

- The Department is continuing its work as a critical part of the President's initiative on nanoscience. As the Chairman has noted, the Department is a major contributor in the nanotechnology field, and we intend to continue our leadership role by fully funding the construction of five nanoscience centers. These will be unique and essential facilities to help us realize the remarkable promise of nanotechnology.

These initiatives work together. For example, materials work from nanoscience will contribute to advanced fuel cell work, and fusion will one day perhaps give us the hydrogen we need to run those fuel cells.

We are fortunate to have a strong and well recognized global technology leadership role. As will become clear in the testimony that follows, many of the technologies that contribute to energy independence also contribute to reducing greenhouse gas emissions. The President's National Climate Change Technology Initiative (NCCTI) will help inventory and prioritize all climate change activities within the $1.6 billion worth of technology R&D that is included in the scope of the Climate Change Technology Program (CCTP), including clean coal, natural gas and other carbon management activities in fossil energy R&D. Within the CCTP the National Climate Change Technology Initiative (NCCTI) Competitive Solicitation program the budget requests $40 million to competitively award cost-share projects to research and develop technology that can help avoid, reduce, or sequester, greenhouse gases emissions.

Let me assure the Committee that we recognize that all programs in the Department, not just these initiatives, must be managed to provide the taxpayer with the maximum benefit. We take the President's Management Agenda very seriously. Each of the programs at the Department has undergone, or is currently working on, a major restructuring, as well as bringing its programs in line with critical performance measures.

Before addressing the specifics of our research and development programs for FY 2004, I would like to point out that research underpins almost every major program activity in the Department. Scientific research is the key to ensuring the reliability of our nuclear deterrent, and to the contributions that our national laboratories are making to counter-terrorism. It was also the key to the decision to move forward with the Yucca Mountain site as a repository for nuclear waste, a decision supported by 20 years and $4 billion worth of scientific study conducted by some of the world's preeminent scientists and carefully reviewed by outside bodies, including the International Atomic Energy Agency.

Let me now review the program areas within my area of responsibility in greater detail.

The Office of Science

Overview. The FY 2004 budget request for the Office of Science supports the President's goal of ensuring continued U.S. leadership in science, and will enable the Office of Science to continue to support the Departments' missions in energy, environment and national security. Our economy, our energy security and our national security depend upon scientific discovery, which is the driver for technological innovation, and the Office of Science is a vital part of the Nation's scientific base. It is the largest single funding source for basic research in the physical sciences, and has provided approximately 40 percent of all federal funds in this area over the past decade. It is also the steward, and by far the principal funding agency, of the Nation's research programs in high-energy physics, nuclear physics and fusion energy sciences, as well as being the Federal Government's largest single funder of materials and chemical sciences.

The Office of Science also supports unique or critical pieces of U.S. research in scientific computation, climate change, geophysics, genomics, and the life sciences. This research is conducted at both the Department's national laboratories and at approximately 250 universities nationwide. The Office of Science manages the construction and operation of some of the Nation's most advanced research and development facilities—a vital part of the Nation's scientific infrastructure used by over 18,000 researchers annually.

The Department is aware of its obligation to manage these important resources well and to provide maximum benefit to the Nation. The Administration's FY 2004 evaluation of Office of Science found that they had clearly defined purposes and were generally well managed, and has also cited our process of "Lehman Reviews" of construction projects as a ". . .widely recognized effective practice." We are also automating many of our routine operations and by the end of FY 2004 100 percent of grant and contract proposals will be received electronically by the Office of Science, 65 percent of purchase orders will done electronically, and 80 percent of

field work proposals will be processed electronically—including 100 percent of new projects. I would also note that the effectiveness of the management of our scientific programs is attested to by a history of success, the most recent example being the award of the 2002 Nobel Prize in Physics to Dr. Raymond Davis for his pioneering observations of neutrinos from the Sun, and the stunning discovery of neutrino mass and neutrino transmutations. We share this success proudly with the National Science Foundation, which also supported Dr. Davis's research.

The Office of Science is now in the process of implementing a restructuring to improve oversight of our laboratories by removing a layer of line management, and instituting clear chains of responsibility in accordance with the principles of the President's Management Agenda.

The Office of Science FY 2004 budget request is $3.311 billion, compared to the $3.264 billion requested in FY 2003. This provides an effective increase for science of 4.5 percent when the ramp-down in construction projects is considered, allowing us to increase support for high priority scientific research, continue operation of our large scientific user facilities, keep existing construction projects on schedule, and support new initiatives.

Office of Science research programs are managed in six major areas, and also include a restructured and enhanced effort in science education:

Fusion Energy Sciences. On January 30th, President Bush announced our intention to join the ITER project. The Department of Energy is the lead U.S. agency in this effort. ITER will allow us to explore the physics of a burning plasma—the essential next step in realizing the promise of commercially available fusion power. In 1997 the U.S. decided to allow the agreement covering U.S. participation in ITER to expire. At the time, the U.S. government had concerns about the scale of the ITER program and the ability of established management and financial structures to protect the U.S. taxpayer. In the meantime, the program has been rescaled and rebudgeted. A recent "Lehman review" of the management and cost estimates at ITER combined with scientific reviews performed by the National Research Council and DOE's Fusion Energy Science Advisory Committee have provided a strong basis for President Bush's January 30th decision to join the ITER negotiations.

We have dedicated $12 million within the FES program budget for FY 2004 to support research directly tied to our participation in the ITER project.

The Office of Fusion Energy Sciences will also continue its other programs of research to advance plasma science and fusion science, including its partnership in basic plasma science with the National Science Foundation. It will continue the operation of DIII–D, Alcator C–Mod and the National Spherical Torus Experiment and investigate alternative fusion concepts that may improve the economic or environmental possibilities for fusion energy. The Office of Fusion Energy Sciences will also continue its basic research in inertial fusion energy in concert with the National Nuclear Security Administration.

As the Committee is aware, fusion energy has many potential advantages over current methods of electricity generation, not the least of which is a possible future contribution to the hydrogen-based economy through the emission-free production of hydrogen.

Advanced Scientific Computing Research. The Office of Advanced Scientific Computing Research provides the high performance computational and networking resources that are indispensable tools for discovery. The capabilities of terascale computing are transforming the conduct of science, bringing scientific simulation through computational modeling to parity with theory and experiment as a scientific tool. The Office of Advanced Scientific Computing Research also funds basic research in mathematical methods and computer science that enable scientists to more effectively use these resources. Every Energy Science and Environment mission area is likely to benefit from scientific insights generated through computational modeling on high end supercomputers in areas ranging from combustion processes to design of new materials to the movement of wastes and other contaminants through the environment.

The Office of Advanced Scientific Computing Research is at the center of efforts to realize the full potential of scientific simulation to solve mission related problems. It will support the Scientific Discovery through Advanced Computing program, a set of coordinated investments that cross-cuts Office of Science research programs. This program is a multidisciplinary effort involving teams of mathematicians, computer scientists, and application area scientists working to develop a new set of scientific simulation codes that can fully exploit today's terascale computing resources.

In FY 2004, $14 million is dedicated to a new Next Generation Architecture program to optimize computer architecture to meet the special requirements of scientific problems. This effort will include both evaluation of the impact of alternative

architectures on application performance, and software research on next generation operating systems.

The Office of Advanced Scientific Computing Research will continue to support existing research programs and facilities, such as the National Energy Research Scientific Computing Center at Lawrence Berkeley National Laboratory, now being upgraded to double its capability to support leading edge science.

Basic Energy Sciences. The Office of Basic Energy Sciences is responsible for construction and operation of the world's premier suite of large scientific user facilities, and is a principal federal sponsor of fundamental research in the areas of materials sciences and engineering, chemistry, geosciences, and bioscience as it relates to energy. In FY 2004, the request for the Office of Basic Energy Sciences will increase funding for the President's initiative in nanoscience by $64 million to $193 million. This will allow construction to proceed on a Nanoscience Research Center at Oak Ridge National Laboratory, as well as new construction of Nanoscience Research Centers at Lawrence Berkeley National Laboratory and Sandia National Laboratory in partnership with Los Alamos National Laboratory.

It also provides Project Engineering Design funding for an Nanorscience Research Center at Brookhaven National Laboratory and funds a Major Item of Equipment for a Nanoscience Research Center at Argonne National Laboratory, where the State of Illinois is funding the construction of the building. When complete, these centers will enable the nanoscale revolution by co-locating multiple research disciplines and a wide variety of nanoscience instrumentation, and their siting near existing light sources or neutron sources will allow rapid characterization of newly fabricated materials. This centralization of resources will provide "one-stop shopping" for scientists who now must often go to widely dispersed facilities to complete their research.

The FY 2004 budget also provides for continued research in materials science and engineering, chemistry, geosciences and energy bioscience as well as high level operation of existing user facilities. It continues funding for construction of the Spallation Neutron Source, which, following a rebaselining and rescoping exercise in 2001, is now on budget and schedule for completion in June of 2006. Our request will also fund project engineering design work for the proposed Linac Coherent Light Source, a 4th generation light source to provide very short pulse x-ray light which is orders of magnitude higher in intensity than today's synchrotron radiation light sources, offering unprecedented opportunities to, for example, observe the dynamics of chemical reactions to develop a deeper understanding of chemical processes.

Biological and Environmental Research. The Office of Biological and Environmental Research supports fundamental research in climate change, environmental remediation, genomics, proteomics, radiation biology, and medical sciences. The FY 2004 budget provides $59 million, an increase of $24 million for the continued growth of the Genomes to Life program, and $25 million, an increase of $22 million for the Climate Change Research Initiative. The Genomes to Life program will develop new knowledge about how organisms grow and function and will marry this to a national infrastructure in computational biology to build a fundamental understanding of living systems. The thrust of Genomes to Life is aimed directly at DOE concerns: developing new sources of energy; mitigating the long-term impacts of climate change through carbon sequestration; cleaning up the environment; and protecting people from adverse effects of exposure to environmental toxins and radiation.

The Climate Change Research Initiative will extend research in climate modeling, atmospheric composition and the regional impacts of climate change. Under the integrative and strong leadership of the Department of Commerce, our office has concentrated on fundamental science to address critical climate issues. Work on the carbon cycle will investigate what fraction of carbon dioxide emissions are taken up by terrestrial ecosystems. Beginning in FY04, ecological research efforts will begin to bridge the knowledge gap between our understanding of molecular-level effects and the responses of entire ecosystems. Ultimately, this knowledge will enable us to predict reliably how ecosystems will react to changes in our environment.

In FY04 the Office of Biological and Environmental Research will continue to explore new clean-up strategies, including bioremediation and treatment of radioactive wastes. The goals of the Environmental Management Science Program, transferred in FY 2003 from Environmental Management, are to develop and validate technical solutions to complex problems, provide innovative technical solutions where there are none, and lead to future risk reduction and cost and time savings. The Environmental Management Science Program request of approximately $29 million in FY 2004 will continue to support these goals, but with increased focus on integrated,

multidisciplinary research to provide decision-makers better information on which to base their decisions. The budget request for the Office of Biological and Environmental Research also provides continued support for the Environmental Molecular Sciences Laboratory, a facility that brings state-of-the-art experimental and computational capabilities to the environmental community to improve our understanding of complex molecular interactions in the environment and our ability to predict contaminant behavior.

Finally, the Office of Biological and Environment Research will continue to take advantage of the insights and expertise that result from its work across many scientific disciplines—materials science, biology, physics, and computation—to provide the medical community with novel devices to detect, diagnose, and treat disease.

High Energy Physics. The High Energy Physics program supports almost 90 percent of U.S. research in high energy physics that is coordinated with the research of the National Science Foundation high energy physics program through a jointly chartered advisory committee, the High Energy Physics Advisory Panel. This research has the goal of developing a deeper understanding of the basic nature of matter, space time and energy. The FY 2004 request will fund continued world leadership in this research. We will continue to pay very close attention to luminosity concerns at the Tevatron and Fermi Laboratory will also continue construction of the NuMI/MINOS experiment, which is now on schedule and within budget, following a rebaselining exercise in 2002. The B–Factory at Stanford Linear Accelerator Center, operating well above its design luminosity, will also continue its program of research to understand why there is a preponderance of matter over antimatter, a critical question in the evolution of the universe. As part of an increasing emphasis on non-accelerator-based research projects, funding will be increased for the Supernova Acceleration Probe at Lawrence Berkeley National Laboratory, a space-based experiment to explore the nature of "Dark Energy," an unknown force that is accelerating the expansion of the universe.

Nuclear Physics. The Departments' nuclear physics research program is the principal sponsor of nuclear physics research in the U.S., providing 85 percent of federal support, and is coordinated with the research of the National Science Foundation's nuclear physics program through a jointly chartered advisory committee, the Nuclear Science Advisory Committee. This research seeks a deeper understanding of the properties of nuclear matter. For FY 2004, a primary focus of the program will be to exploit the capabilities of the world's finest experimental facilities for nuclear physics. At the Brookhaven National Laboratory's Relativistic Heavy Ion Collider, researchers will continue efforts to create and study the plasma of unconfined quarks and gluons believed to have existed a microsecond after the "Big Bang." At the Continuous Electron Beam Accelerator Facility located at the Thomas Jefferson National Accelerator Facility, high energy beams of electrons will probe the internal structure of nucleons. To optimize the utilization and scientific productivity of these and other experimental facilities required some difficult decisions. As a result, in a decision informed by the priorities recommended by the Nuclear Science Advisory Committee, operation of the 88-Inch Cyclotron at Lawrence Berkeley National Laboratory will be terminated.

Recent results from neutrino physics experiments have provided indications of new physics beyond the Standard Model, and funding has been increased to support non-accelerator-based experiments such as the international collaborations at the Sudbury Neutrino Observatory, KamLand and elsewhere for further investigation of these results.

Workforce Development for Teachers and Scientists. Formerly known as "Science Education" and budgeted as a subprogram in the Science Program Direction budget, this program will continue the existing activities of the Science Education program. It will also begin a pilot program at Argonne National Laboratory, funded at $1 million, to exploit the resources of the national laboratories to provide professional development for K–14 science and mathematics teachers, who are the key to fostering interest in mathematics and science among students. Teachers will be competitively selected and matched with laboratory mentors working in their field of instruction. They will then spend 4–8 weeks at a laboratory performing research mentored by both laboratory scientists and "master teachers" who can help them transfer the laboratory research experience to the classroom. This will be the first step in a continuing relationship with the laboratory that will include additional one week on-site mentoring sessions and continuing communication. Intensive follow-up and performance measures will be applied to assess the results of this pilot.

This initiative, in response to the President's call for a "qualified teacher in every classroom," will bring some of the Nation's finest scientific and technical resources to bear on improving the quality of instruction in science and mathematics to address a critical national problem—developing a technically trained and educated workforce for the 21st century.

The Office of Nuclear Energy, Science and Technology

Overview. Over the last thirty years, nuclear power has risen to become one of the most important sources of electric energy in the United States and at the same time, among the most operationally economic. The benefits of nuclear power as a clean, reliable and affordable source of energy are a key to the economic and environmental underpinnings of this Nation. A central mission of the Department's nuclear program is to help enhance the basic technology and, through some of the most advanced civilian technology research conducted today, chart a course to the next leap in technology. In FY 2004, we are proposing a $388 million investment in nuclear research and development and for the Nation's nuclear science, technology and education infrastructure, a nearly twenty percent increase over last year's request.

This budget request responds to the President's priorities to deploy new generation capacity to fortify U.S. energy independence and security while making significant improvements in environmental quality. It builds on the important work started over the last two years to deploy new nuclear plants in the U.S. by the end of the decade, to develop advanced, next generation nuclear technology, to strengthen our nation's nuclear education infrastructure, and proposes exciting new priorities—a new *Nuclear Hydrogen Initiative* to use high temperature nuclear energy systems for clean hydrogen production as part of the President's Hydrogen Fuel Initiative and the *Advanced Fuel Cycle Initiative,* research aimed at developing proliferation-resistant fuel treatment and fuel cycle technologies that can reduce the volume and toxicity of commercial spent nuclear fuel and maximize energy from nuclear fuel.

Also, during FY 2002, the Department proceeded to implement the President's Management Agenda, including a major reorganization to better reflect the Administration's priorities, improve overall management and reduce the number of primary organizational units from eight to three. To assure overall accountability, PMA performance measures were cascaded from the Director, through the management to the staff. High emphasis has also been placed on development of meaningful R&D investment criteria and their application to the nuclear research initiatives. The nuclear program has successfully recruited and hired new junior professional staff and is working to put to new senior management team in place at the Idaho Operations Office, who will oversee nuclear R&D at INEEL as well as completion of the cleanup mission.

Let me expand in more detail on the Department's nuclear energy initiatives, and the linkages of these initiatives among one another.

Advanced Fuel Cycle Initiative. Of the issues affecting future expansion of nuclear energy in the U.S. and worldwide, none is more important or more difficult than that of dealing effectively with spent nuclear fuel. After a long and difficult process, the country is moving forward with a geologic repository, and we are on schedule to submit a license application to the Nuclear Regulatory Commission by the end of 2004.

With these successes, we are able to pursue research that can optimize the use of the first repository and possibly reduce the need for future repositories. For years, countries around the world have pursued advanced technologies that could treat and transmute spent nuclear fuel. For the last three years, the U.S. has been a participant in this research. As one of the Secretary's capstones, the FY 2004 budget request proposes an aggressive research and demonstration program, the *Advanced Fuel Cycle Initiative,* with an investment of $63 million in FY 2004 to continue exploring advanced, proliferation-resistant nuclear fuel treatment and transmutation technologies that can reduce volume and toxicity of spent nuclear fuel for a geologic repository. If successful, these same technologies offer benefits of enhancing national security by reducing inventories of commercially-generated plutonium and enhancing energy independence by recovering the energy value contained in spent nuclear fuel.

The Department is proposing a research program leading to a demonstration of proliferation-resistant fuel treatment technology to reduce the volume of high level waste, and development of advanced fuels in the 2015 time frame that could enable consumption of plutonium using existing light water reactors or advanced gas reactors. With the President's request, the Department will continue work toward demonstration of proliferation-resistant fuel treatment technology and continue design of transmutation fuels for future use with current reactor technologies.

However, for the Advanced Fuel Cycle Initiative to be successful, advanced fuel treatment and transmutation research and development must be integrated with the development of *Generation IV* nuclear energy systems, particularly with those reactor technologies that can produce very high energy neutrons that would be needed to transmute a wide variety of toxic radioactive species. To support this goal, the Advanced Fuel Cycle Initiative will develop the advanced proliferation resistant fuels and fuel cycle systems for *Generation IV* reactors.

Generation IV Nuclear Energy Systems. Two years ago, we launched the *Generation IV* program to develop advanced reactor technologies for commercial deployment after 2010 but before 2030. These advanced reactors offer significant advances in sustainability, proliferation-resistance, physical protection, safety and economics. Development of these reactors is being pursued by the *Generation IV International Forum,* a group of ten leading nuclear nations (United Kingdom, Argentina, Brazil, Canada, France, Japan, Republic of Korea, Republic of South Africa, Switzerland, and the United States), who last year selected six promising technologies for joint research, development, and demonstration. While the Department has not yet decided upon which of these technologies it will eventually focus, all of the technologies are of considerable interest. The six innovative, next-generation technologies include two gas-cooled reactors, one water-cooled, two liquid-metal-cooled reactors, and a molten salt-based reactor concept.

Key research objectives for these technologies will include such activities as demonstrating advanced fuels and materials. The goal of the initiative is to resolve the fundamental research and development issues necessary to establish the viability of these concepts. By successfully addressing the fundamental research and development issues, the concepts are highly likely to attract future private sector sponsorship and ultimate commercialization. In FY 2003 and FY 2004, the Department will establish international partnering agreements to guide joint research and begin research and development on several of the reactor concepts, including very high temperature reactors that would be suitable for efficient production of hydrogen.

Nuclear Hydrogen Initiative. *Generation IV* is closely linked to our new *Nuclear Hydrogen Initiative,* aimed at demonstrating economic commercial-scale production of hydrogen using nuclear power no later than 2015. The use of hydrogen using high temperature advanced reactors such as advanced gas-cooled or liquid metal-cooled reactors can provide the heat necessary for the process. These technologies offer the potential for large-scale, emission-free, hydrogen production capability needed to fuel a hydrogen economy. Today, through electrolysis, we can convert water to hydrogen using electricity but we believe that for the future, high temperature nuclear energy systems coupled with thermo-chemical water splitting processes offer a more efficient technology for production of large quantities of hydrogen, without release of greenhouse gases.

The hydrogen initiative grew out of the success of our *Nuclear Energy Research Initiative,* in particular, two investigator-initiated projects that identified a number of advanced reactor concepts capable of producing large quantities of hydrogen with high efficiency and low cost. Since then, we have awarded an additional three projects and the International component of the Nuclear Energy Research Initiative has awarded one research project studying nuclear production of hydrogen. The *Nuclear Hydrogen Initiative* builds on the research from the Nuclear Energy Research Initiative and International Nuclear Research Initiative to demonstrate the ability to use nuclear to produce hydrogen with high efficiency and low cost. In FY 2004, we propose to invest $4 million to begin this initiative by developing a Nuclear Hydrogen Technology Roadmap and to conduct laboratory-scale demonstration of some of the key processes involved in nuclear hydrogen production.

Nuclear Power 2010. The President's budget supports continuation of *Nuclear Power 2010* in FY 2004 to demonstrate, in cost-shared cooperation with industry, key regulatory processes associated with licensing new nuclear plants in the U.S. In FY 2004, the requested funds would support the activities associated with submitting and achieving NRC approval of early site permits and development of Combined Construction and Operating License applications.

Most, if not all, of our research initiatives involve participation by U.S. universities. The Advanced Fuel Cycle Initiative, for example, proposes to resume a fellowship program aimed at attracting graduate and doctoral students to the discipline of transmutation science. Other programs, like the Nuclear Energy Research Initiative, sponsor research conducted in large part by universities as well as national laboratories and the private sector.

University Reactor Fuel Assistance and Support. For years, the Energy Department has sponsored an initiative that supports nuclear science and technology

educational infrastructure through our *University Reactor Fuel Assistance and Support initiative.* The need for trained and qualified nuclear scientists has not diminished over the years, and in fact, because of increasing retirements in the nuclear field, demand today exceeds supply.

We are very pleased that the President's budget includes $18.5 million for this program for fellowships, scholarships, nuclear engineering research, and for critical support to university research reactors. In FY 2002, the Department launched the *Innovations in Nuclear Infrastructure and Education* program, encouraging universities to form ground-breaking partnerships with national labs, the private sector, and other universities to strengthen nuclear engineering education and optimize the use of research reactors. In FY 2002, DOE issued awards to four consortia of universities and their partners. With an additional $1 million requested in FY 2004, we hope to support additional awards.

INEEL—DOE's Command Center for Nuclear R&D. Finally, this budget supports the Secretary's realignment of the mission of the Idaho National Engineering and Environmental Laboratory to focus the future of the site on nuclear research and development. As the Department's leading center of nuclear research and development, this laboratory is the "command center" for our efforts to develop advanced reactor and fuel cycle technologies, including development of space nuclear power and propulsion technologies.

While the nuclear energy program involves the collective talents of universities, the private sector, international partners, and our national laboratories—Argonne, Los Alamos, Sandia, and Oak Ridge among them—the rebuilding of the Departments' nuclear program that is underway today for our nation's long-term energy security will not possible without the dedicated scientists, engineers and supporting staff of the Idaho National Engineering and Environmental Laboratory. Clearly, environmental cleanup will remain a major focus of the Department for the near-term but real progress is being made that will clear the way for expansion of nuclear research and development. With this year's budget, $110 million has been transferred from the environmental cleanup program to the Department's nuclear program to manage laboratory infrastructure and security.

The Office Energy Efficiency and Renewable Energy

Overview. The overall FY 2004 budget for the Office of Energy Efficiency and Renewable Energy is $1.320 billion, compared to $1.319 billion requested in FY 2003. The request reflects support to carry out National Energy Policy recommendations, the Department's mission, program priorities, and the Energy Efficiency and Renewable Energy Strategic Program Review recommendations.

The FY 2004 Budget also reflects the new organization within the office. Two years ago, the Office of Energy Efficiency and Renewable Energy was divided into 31 programs, in 17 offices, stove piped into 5 market sectors. There were multiple overlapping layers of management; and duplicative and inconsistent business systems that generated significant inefficiencies and made it difficult to ensure accountability.

In response to the President's Management Agenda, we launched a dramatic restructuring of the program in April 2002. This restructuring eliminated the five market sectors and 17 offices, streamlined 31 programs into 11, eliminated up to four management levels, and centralized administration functions into a single support organization with a focus on developing consistent, uniform, and efficient business practices. This is the most dramatic restructuring of the Office of Energy Efficiency and Renewable Energy in at least a dozen years and arguably in its history.

The restructuring combined all the hydrogen and fuel cell activities, formerly scattered across two market sectors and three programs, into a single program for greater efficiency.

The restructuring also combined all the bioenergy-related activities, formerly scattered across three market sectors and three programs, into a single program focused on advanced biorefineries.

The FY 2004 budget is fully aligned with the new management structure and strategic goals and together they will provide greater synergy and increased efficiency and productivity in research and development and deployment activities.

Research and development and technology deployment efforts supported by the FY 2004 budget will provide Americans with greater freedom of choice of technology, while providing increased energy security, and reducing financial costs and impacts on the environment.

The FY 2004 budget has been developed with these challenges and opportunities in mind.

Hydrogen Fuel Initiative. The big news in the FY 2004 budget is, of course, the President's Hydrogen Fuel Initiative. The President's Initiative directly supports EERE's number one priority to dramatically reduce or even end dependence on foreign oil.

America currently depends on foreign sources for 60 percent of its oil—a dependence that is projected to rise to 70 percent by 2025. Since two thirds of the oil we consume is used for transportation, we must focus on alternative means of fueling transportation from domestic resources if we ever expect to reverse this trend.

In his recent State-of-the-Union address, President Bush announced a new research and development initiative focused on hydrogen that, in conjunction with FreedomCAR launched last year, will help reverse America's growing dependence on foreign oil and expand the availability of clean, abundant energy.

The President's Hydrogen Fuel Initiative will accelerate research and development on hydrogen production, delivery, storage and distribution, and establish the necessary safety-related codes and technology standards. The initiative also will fund limited "learning" demonstrations of fuel cell vehicles and hydrogen infrastructure so that these technologies can be validated under real world conditions. When the President's vision of a child born today driving a hydrogen fuel cell vehicle is achieved, hydrogen fuel cells also could power our nation's homes, schools and businesses.

The hydrogen needed to fuel these vehicles and stationary power sources is domestically available in abundant quantities as a component of natural gas, coal, biomass and even water through electrolysis using renewable or nuclear power. In the future, we may well also look to fusion energy to power a hydrogen economy. The *challenge* is to economically produce, deliver, store and distribute hydrogen for use as a consumer fuel in a cost-effective and environmentally-sound way, and to engage the broader oil, energy and power companies in this effort.

To support the President's vision we need to make the necessary research and development investments to develop vehicles powered by hydrogen fuel cells and the infrastructure to support them. The government role will be to fund and coordinate the high-risk R&D work of numerous private sector partners and our national network of science laboratories. Government coordination of this undertaking will help resolve one of the difficulties associated with development of a commercially viable hydrogen fuel cell vehicle: the "chicken and egg" question. Which comes first, the fuel cell vehicle or the hydrogen production and delivery refueling infrastructure to support it? The President's Hydrogen Fuel Initiative, in conjunction with the FreedomCAR partnership, answers the question by proposing to develop both in parallel; that is, to augment the already significant investment in vehicle technologies with new investments in hydrogen and fuel cell technologies. By so doing federal investments can help to advance commercialization of hydrogen fuel cell vehicles and infrastructure by 15 years, from 2035 to 2020.

To meet this challenge, the President's FY 2004 budget commits $1.2 billion for hydrogen and fuel cells over five years ($720 million in new money); including in FY 2004 $181 million for the DOE (mostly EERE) and 0.7 million for the Department of Transportation.

The Hydrogen Fuel Initiative enhances and complements the FreedomCAR partnership announced last year. FreedomCAR is a public-private partnership with U.S. automakers to accelerate the development of practical, affordable hydrogen fuel cell vehicles. The funding request for the Hydrogen Fuel Initiative and FreedomCAR combined will total $1.7 billion over five years.

The funding request for the vehicle technologies program under the FreedomCAR umbrella increases from $74.4 million in our FY 2003 budget to $91.1 million in FY 2004. This will increase the research and development emphasis on battery and materials technologies critical for fuel cell and combustion hybrid vehicles over five years; in FY 2004, the total DOE FreedomCAR and Fuel request is $272.1 million.

The funding request for the Fuel Cell Technology Program—which includes the development of polymer electrolyte membrane fuel cell technology in support of this initiative—increases from $57.5 million in our FY 2003 budget to $77.5 million in FY 2004. This increase will support, as noted above, a limited "learning" demonstration project for fuel cell vehicles and hydrogen infrastructure (with hydrogen subprogram) to integrate and validate component technologies; and an increase for fuel cell component research and development to reduce fuel cell cost.

The funding request for the Hydrogen Technology Program increases from $39.9 million in our FY 2003 budget to $88.0 million in FY 2004 (plus $15.5 million in the Fossil Energy and Nuclear Energy programs, for a total of $103.5 million). This will be used to establish a national research effort on hydrogen storage; enhancing technology development for hydrogen production from renewables and distributed natural gas; accelerate codes and standards development; create a major hydrogen

education effort; and validate hydrogen infrastructure technologies to support fuel cell vehicle test and evaluation.

These efforts support the President's Initiative, and will enable the development of hydrogen fuel cell vehicles for the showroom floor by 2020. Success of these programs will begin to eliminate the need for imported oil, while simultaneously reducing emissions and greenhouse gases from America's transportation fleet without affecting the freedom of personal mobility we demand.

Efficient Lighting Systems. The FY 2004 budget also will expand our research and development in Solid State Lighting, which represents a promising new approach to efficient lighting systems.

The lighting used in our homes and offices today is in many ways similar to the vacuum tubes that preceded solid state electronics. This comparatively inefficient lighting consumes about 7 quadrillion British thermal units of the Nation's energy each year and contributes to the peak energy demands that strain our electricity infrastructure. Advancing the technology and lowering the cost of organic and inorganic light emitting diodes will lead to more efficient, flexible and functional lighting technology in the future.

For FY 2004, we are proposing a $5 million investment to expand our Solid State Lighting research activities. Our Solid State Lighting research will create the technical foundation to revolutionize the energy efficiency, appearance, visual comfort, and quality of lighting products.

The Office of Fossil Energy

Overview. The Fossil Energy program is being realigned to focus virtually exclusively on supporting three of the President's top energy and environmental initiatives: *Clear Skies, Climate Change,* and *Energy Security.*

To be included in the FY 2004 budget, Fossil Energy programs must either (1) support the development of lower cost, more effective pollution control technologies or help diversify the Nation's future sources of clean-burning natural gas to meet the President's *Clear Skies* goals; (2) expand the Nation's technological options for reducing greenhouse gases either by increasing power plant efficiencies or by capturing and isolating these gases from the atmosphere; or (3) measurably add to the Nation's energy security by providing a short-term emergency response (e.g., Strategic Petroleum Reserve) or a longer-term alternative to imported oil (e.g., hydrogen and methane hydrates).

The President's Coal Research Initiative. The President's Coal Research Initiative accounts for $320.5 million of the Fossil Energy research and development budget request. Since our budget testimony last year, the Department has made significant progress in implementing the initial stage of the President's $2 billion, 10-year commitment to a new generation of environmentally-clean coal technologies.

Our "first round" solicitation in the Clean Coal Power Initiative—a key piece of the President's clean coal commitment—attracted three dozen proposals for projects totaling more than $5 billion. On January 15, 2003, we announced the first winners of this competition—eight projects with a total value of more than $1.3 billion, more than one billion dollars of which would be provided by the private sector.

In FY 2004, we are requesting $130 million for the Clean Coal Power Initiative to fund joint government-industry research projects on new technologies that can enhance the reliability, efficiency, and environmental performance of coal-fired power generators.

To ensure that even more effective pollution controls continue to emerge in support of the President's *Clear Skies Initiative,* we are requesting $22.0 million for research into even cleaner and more affordable environmental innovations for existing plants.

Several of the recently-selected Clean Coal projects also expand the menu of options for meeting the President's *Climate Change Initiative,* primarily by boosting the efficiencies of power plants (meaning that less fuel is needed to generate electricity with a corresponding reduction in greenhouse gases). To position even more advanced, high efficiency power generating concepts for future development and testing, we are requesting $64.0 million to continue research into integrated gasification-combined cycle and a companion effort in high-performance, multi-fuel-capable turbines. A key aspect of these advanced power concepts—which will make up key modules of our "Vision 21" emission-free power plant of the future—is that they emit carbon dioxide in a way that makes the greenhouse gas easier to capture.

Carbon management will become an increasingly important element of our coal research program. Carbon sequestration—the capture and permanent storage of carbon dioxide—has emerged as one of our highest priorities in the Fossil Energy re-

search program—a priority reflected in the proposed budget increase to $62.0 million in FY 2004 compared to an FY 2003 amended request of $44.0 million.

Carbon sequestration, if it can be proven practical, safe, and affordable, can dramatically enhance our long-term response to climate change concerns. It could offer the United States and other nations the option to reduce greenhouse gases that would not necessitate potentially disruptive and economically harmful changes in the way we produce, deliver, or use energy.

Beginning in FY 2004, one of the cornerstones of our carbon sequestration program will be a national network of regional partnerships. This Secretarial initiative will bring together the Federal Government, state agencies, universities, and private industry to begin determining which options for capturing and storing greenhouse gases are most practicable for specific areas of the country. We hope to start about four of these partnerships in FY 2004.

Among the research pathways we are pursuing in support of the Administration's Hydrogen Fuel Initiative will be innovative approaches for producing carbon-free hydrogen from coal by integrating coal-based hydrogen production technologies with permanent, stable carbon storage. Coal is a very attractive source of hydrogen through the coal gasification process. We have allocated $5.0 million for research into new methods for making hydrogen from coal.

To provide fundamental scientific knowledge that benefits all of our coal technology efforts, our FY 2004 budget also includes $37.5 million for advanced research in such areas as materials, coal utilization science, analytical efforts, and support for coal research at universities (including historically black and other minority institutions).

Other Power Systems Research and Development. We are also proposing $47 million for continued development of fuel cells with an emphasis on lower-cost technologies that can contribute to both *Clear Skies* emission reductions, particularly in distributed generation applications, and *Climate Change* goals by providing an ultra-high efficiency electricity generating component for tomorrow's power plants. Distributed power systems, such as fuel cells, also can contribute to the overall reliability of electricity supplies in the United States and help strengthen the security of our energy infrastructure.

Natural Gas Research. In response to the President's *Clear Skies Initiative,* the department is requesting $26.6 million for natural gas research. This clean-burning fuel will be integral to achieving the goals of *Clear Skies.*

Our natural gas research program, therefore, is directed primarily at research and development that can improve our utilization of this resource and provide sound science for policy decision-making. A particularly important aspect of this research will be to develop innovative ways to recover this resource from other sources such as hydrates, and to use natural gas to produce hydrogen.

The most significant new initiative in our Natural Gas Research program is the work we are proposing in hydrogen as part of the President's Hydrogen Fuel Initiative. We are requesting $6.5 million to study innovative methods to produce hydrogen from natural gas. We will ask industry, academia, and our national laboratories to submit new ideas on hydrogen production and related research. Since the byproduct of gas-to-hydrogen processes will likely be carbon dioxide, this effort will also include research on carbon capture and sequestration. This work will be closely coordinated with other efforts in the Office of Fossil Energy to capture and sequester carbon dioxide.

Over the long-term, the production of natural gas from hydrates could have major energy security implications. Hydrates—gas-bearing, ice-like formations in Alaska and offshore—contain more energy than all other fossil energy resources. The ability to develop hydrates as a natural gas source would be able to provide all our natural gas needs. Understanding hydrates can also improve our knowledge of the science of greenhouse gases and possible offer future mechanisms for sequestering carbon dioxide. For these reasons, we are maintaining a research program to study gas hydrates with a proposed funding level of $3.5 million.

Natural gas storage and transportation will also assume increasing significance in the United States as more and more power plants require consistent, year-round supplies of natural gas. Toward this end, we will initiate a nationwide, industry-led consortium that will examine ways to improve the reliability and efficiency of our nation's gas storage system and explore opportunities for liquid natural gas facility siting. We recognize that it has been decades since liquid natural gas has been a significant natural gas supply option. Through this new program, we are working to integrate thirty years of advances in technology, science and policy to secure the reliability of liquid natural gas storage and transport.

Oil Technology Development. The President's National Energy Policy calls attention to the continued need to strengthen our nation's energy security by promoting enhanced oil (and gas) recovery and improving oil (and gas) exploration technology through continued partnerships with public and private entities.

We also recognize that the federal oil technology research and development program must be more focused in order to achieve results and accomplish Presidential and departmental goals. Consequently, our FY 2004 budget request of $15.0 million reflects a reorientation of the program toward those areas where there is clearly a national benefit and the ability to contribute to the climate change and energy security goals.

The research and development activities directed towards the use of carbon dioxide injection to enhance the recovery of oil from existing fields will help achieve our climate change goals through an effective carbon sequestration method. Carbon dioxide injection is a proven enhanced oil recovery practice that prolongs the life of some mature fields, and the private sector has not applied this technique to its fullest potential due to insufficient supplies of economical carbon dioxide. A key component of carbon sequestration to be carried out in our proposed FY 2004 program will be to facilitate the greater use of this process by integrating it with carbon dioxide-captured and delivered from fossil fuel power plants.

We will also refocus much of our Oil Technology program on a new Domestic Resource Conservation effort that will target partnerships with industry and universities to sustain access to marginal wells and reservoirs. These aging fields account for 40 percent of our domestic production, yet contain billions of barrels of oil that might still be recovered with ever-improving technology. A high priority effort in FY 2004 will be to develop "micro-hole" technology. Rather than developing just another new drilling tool, the federal program will integrate "smart" drilling systems, advanced imaging, and enhanced recovery technologies into a complete exploration and production system. Micro-hole systems may offer one of our best opportunities for keeping marginal fields active because the smaller-diameter wells can significantly reduce exploration costs and make new drilling between existing wells ("infill" drilling) more affordable. This will enable us to maintain a consistent base of domestic oil production.

Other Fossil Energy R&D. Our budget request also includes $124.3million for other activities in our Fossil Energy program, including $92.8 million for headquarters and field office salaries, $3.0 million for plant and capital improvements, $9.8 million for environmental restoration, $6 million for federal matching funds for cooperative research and development projects at the University of North Dakota and the Western Research Institute, $2.8million for electricity and natural gas import/export responsibilities, and $10 million for advanced metallurgical research at our Albany Research Center. The increase in funding at the Albany Center (up from $5 million in FY 2003) reflects the Center's growing role in developing better materials for fuel cells and in studying new mineral carbonation concepts for carbon sequestration.

Conclusion

As the Committee is well aware, this testimony has not covered the enormous contributions science in our National Nuclear Security Administration (NNSA) is making to the DOE mission. From material research to high-performance computing, NNSA science is integrated into the full range of activities within my area of responsibility.

Mr. Chairman, I believe the Department's FY 2004 budget submission meets the Nation's critical needs for energy, environmental and national security at a difficult time in our history. The Committee has a central role in shaping the future of science and technology in the United States. The Department of Energy, which Secretary Abraham has said might well be called the Department of Energy and Science, hopes to join the Members of the Committee in working to strengthen American science.

BIOGRAPHY FOR ROBERT G. CARD

As Under Secretary, Mr. Card has line responsibility for Departmental operations in Energy, Science, and Environment. Energy responsibilities include renewables, fossil, nuclear and nuclear fuel cycle management, space nuclear power, power transmission, energy conservation and energy efficiency standards. In the area of science, the Department is the largest federal funder for physical sciences covering 14 national laboratories plus university and commercial research engagements. Major elements include basic energy sciences, high energy and nuclear physics, biological and environmental sciences, fusion energy and computing. Environmental op-

erations include nuclear waste management, spent fuel retrieval from commercial, defense and international sources, and remediation of the nuclear weapons complex. Example activities of the Under Secretary during this tenure include responsibility for:

- Implementation of the President's Clean Coal and FreedomCAR initiatives
- Reconfiguration of the Environmental Management program to complete public and worker risk reduction nearly 40 years earlier for over $50 billion of cost savings
- Siting and development of the Nation's high level nuclear waste repository
- Chair of the Interagency Working Group on Climate Change Science & Technology
- Filling the Strategic Petroleum Reserve to its full capacity of 700 million barrels
- The Secretary's Nuclear Power 2010 initiative
- Management improvement initiatives including safety and security improvements, DOE order and requirements streamlining, and project management improvements.

Prior to his DOE employment, Mr. Card was President and CEO, Kaiser-Hill Company, LLC. In that role he was responsible for the $7 billion, 5,000 employee, cleanup and closure of the U.S. Department of Energy's (DOE's) Rocky Flats site, which was formerly one of the Nation's five primary nuclear weapons production sites. The plant, which contained the largest unfinished plutonium stockpile in the Nation, is located in the Denver, Colorado metropolitan area. After assuming responsibility for the project in 1995, Mr. Card restructured site operations and the closure strategy to advance the planned closure schedule of 2065, at a cost $37 billion to a closure goal of 2006, and a total cost of approximate $7 billion.

Mr. Card also served as a Director and Senior Vice President at CH2M HILL Companies, Ltd. The Company had revenues of about $2 billion and was one of the world's larger science, engineering, construction and operations firms. The corporation had major practices in the areas of energy & environment, water, transportation, and industrial manufacturing. Prior to the Rocky Flats assignment, Mr. Card served as Group Executive, Environmental Companies, responsible for the energy and environmental business, which was the firm's largest business practice. This business served a variety of customers including the Federal Government, electric utilities, oil and gas companies and other industries. Mr. Card personally managed the design and construction management of an award-winning heavy oil production project in Canada.

Mr. Card completed the Program for Management Development at Harvard Business School; received a M.S. in Environmental Engineering from Stanford University; and a B.S. in Civil Engineering from the University of Washington.

DISCUSSION

Chairman BOEHLERT. Thank you very much, Mr. Card. Let me say at the outset that this committee, I think—I am confident I can speak for the entire Committee, has great respect and unending appreciation for the professionalism that each of you bring to your job. You have a very demanding task, particularly now when resources are so tight, because of a whole wide variety of factors that are completely beyond the control of anyone in this room. It is sort of unfortunate that we are having this hearing today as the ink is drying on the Omnibus Bill that later today we are going to be considering. But that has to drive what we say and do here today and guide us for the future.

So let me start, first of all, with Dr. Marburger. Now that we are finally beginning to know the '03 appropriation numbers, it puts the '04 request in a different light. Programs that were presented in the Administration's budget as getting small increases, like DOE's Office of Science, would actually end up being cut. Programs that were presented as priorities, like NSF, would actually end up

just about flat-funded in real terms. So my question is how are we supposed to interpret the Administration's proposal for '04? For NSF are we to suppose that the Administration is asking for a three percent increase from the actual fiscal year 2003 numbers, or a nine percent increase, or neither? Will there be a budget amendment set up—sent up? Is there any point at all at looking at the proposed budget as any kind of starting point for spending discussion right now in view of the action that is anticipated within the next several hours?

Dr. MARBURGER. That is an important question to ask. I think it is necessary to regard the President's '04 request as the starting point. It is the base of numbers that we all have to deal with. And it does have important signals, important changes of emphasis. It gives, I think, very good direction for establishing priorities for funding. I understand the discomfort that we all feel about not having the '03 numbers available to us as we planned this budget, but this budget request is planned. It did—it does contain the result of a lot of thinking about priorities and needs within the departments for which the requests are made. And I don't think we have any choice but to regard this budget as the starting point for the discussions that are now going to have to go forward to decide what Congress will do about the '04 budget.

Chairman BOEHLERT. The Administration is somewhat at a disadvantage, because we are so slow in doing our work to give the guidance that the Administration has every right to expect from us. The Committee took the lead in writing portions of the Homeland Security Act dealing with science and technology, and you are very familiar with that. And in that Act, we required a report so we could understand the nature and impact of the transfer of programs from DOE to the Department of Homeland Security.

The report that came up to us in late December was wholly inadequate. And on January 7, I wrote to the President asking a series of pretty basic questions about the transfer. We haven't heard a thing back even though DHS is now up and running. Dr. Marburger, your staff is playing a critical role in setting up the S&T portions of the new department. When do you expect that this committee will receive an answer to our letter? And can you or Mr. Card answer some of the questions that we have been asking right along? And of course, you are both familiar with that letter. Dr. Marburger first.

Dr. MARBURGER. Yes. Mr. Chairman, I understand that your letter has been sent to the Department of Homeland Security for a formal response. I can tell you that the life sciences money is planned to be used to enhance the bio-forensic sequencing capacity needed by DHS and in addition to develop intramural biological sciences capacity for the director that will provide core expertise for that portion of the director's mission space. The amount transferred in fiscal year 2003 is $20 million. The current plan is to have a virtual lab consisting of components of several of the labs: Sandia Los Alamos, Lawrence Livermore reporting to the Office of R&D within the DHS headquarters.

Now it is going to be a while, I suppose, before DHS has its formal response. We will assist them, as we do for all agencies in coordinating interagency science activities, but beyond what I have

been able to tell you about the specifics, I don't have a further answer today.

Chairman BOEHLERT. And let me say, I understand that. I mean, we are all about one of the biggest ventures this government has undertaken in terms of reorganization in the post-World War II era. I pointed the letter out and the particular questions asked so that you will know clearly of our deep and abiding interests. And we are going to work through this to get the answers.

Mr. Card, is there something you might add to Dr. Marburger's statement?

Mr. CARD. I would just like to say, the Department of Energy supports completely the new department. And we are looking forward to serving them. In summary, we don't, frankly, see a very big impact of this change. And I know there is—the budget contains some financial figures, but the greatest is the transfer of a laboratory in terms of FTEs in New York. And we are certainly hoping to be able to get you the final answers, because there are still verier adjustments going on by the 1st of March. But the FTE impact is significantly less than one percent of the federal FTEs, which of course is also only about ten percent of our total DOE workforce.

Chairman BOEHLERT. Thank you very much. And we will look forward to that. Thank you, Dr. Marburger and Mr. Card. Thank all of you. Mr. Bishop.

Mr. BISHOP. Thank you very much, Mr. Chairman. I have some questions for Dr. Marburger, but before I ask those questions, I want to just commend Dr. Marburger for the work he did in restoring public confidence in Brookhaven National Laboratory. It is a very important facility in our district, and confidence was waning, and you did a first-rate job in a very short period of time in restoring that, so thank you very much for that.

Dr. MARBURGER. Thank you.

Mr. BISHOP. I want to focus on Brookhaven Lab. There is a commitment to clean up Brookhaven Lab and the aftereffects of the leak of the tritium from the nuclear reactor. Does this budget remain consistent with the timeline that has been established and agreed to for that cleanup?

Dr. MARBURGER. Mr. Congressman, I am not intimately familiar with that part of the DOE budget request. It is not in the science and technology or R&D part. It is possible that Mr. Card may have a response to that. Bob, I just have to defer to you on this point.

Mr. CARD. Yeah. It is my understanding that we are on track with the cleanup commitments of Brookhaven Lab. And it is part of the Accelerated Cleanup Program. But if there is any change in that, for the record, I will give you a revised answer, but that is my understanding.

Mr. BISHOP. Please do. Thank you. I have two questions of Dr. Colwell. The NSF graduate education assistantship and fellowship program, you are requesting a significant increase. How many additional students will that allow you to accommodate in that program?

Dr. COLWELL. We are hoping to have 350 new fellowships. And I would remind you that the graduate research fellowships and

GK–12 and the IGERT fellowships would be the ones which would be increased, and these require U.S. citizenship.

Mr. BISHOP. What is the rate of acceptance now? I mean, if you were to increase by some 300, how many students, otherwise qualified students, would remain with their needs unaddressed?

Dr. COLWELL. Let me give you some data. Five years ago, the stipend was $15,000. And we had something like 5,000 applicants for the 950 slots. When we started raising the fellowships, with the concurrence of Congress, to most recently $21,500, the number of fellowships have gone up to—applications have gone up to about 6,000. And then when the announcement of the fellowships being $25,000, this year, we have had well over 8,000 applications for the 950 fellowships we have. So clearly, we do have two observations: one is there are many people, young people, who would like to be studying, you know, doing graduate work in the sciences and engineering; and secondly, financial considerations are really very serious. We know that the average graduate has a debt of about $27,000. So it is clear to attract students to graduate work in science and engineering, the stipend is critical.

Mr. BISHOP. By those statistics, there is a significant number of otherwise well qualified students who are not brought into graduate studies supported by the NSF, correct?

Dr. COLWELL. Yes, sir.

Mr. BISHOP. Thank you, Mr. Chairman.

Chairman BOEHLERT. Thank you. The Chair recognizes Dr. Ehlers.

Mr. EHLERS. Thank you, Mr. Chairman. And thank you to the panel. It is very good to see a bunch of home run hitters at the witness table, and you have all done a good job in your work for the Federal Government. I appreciate that.

Just a few quick observations. Dr. Marburger, I am disappointed in the increase for NSF. As you well know, the Congress passed the Doubling Bill for them. I will not flip up the chart I flipped up last year. You probably remember that, but—which showed an extreme imbalance between what had happened to NIH and what had happened to NSF, NIST, and EPA and all of the other labs. It is my goal to redress that imbalance, and the NSF Doubling Bill, thanks to the work of the Chairman and of Congressman Smith, has passed, been signed into law, and we would like to have the Administration fund that. The NSF, compared to the actual past fiscal year 2003, is on a four percent increase. If we accepted that, that would be—already put us 14.2 percent behind the Doubling Plan we have. And so I can assure you that Members of the Congress will be trying to increase that as we go through the process.

Dr. Bodman, I—in regard to NIST, etcetera, both you and I agree that NIST has done some great things and has—considering the funding, it has done extremely well, two Nobel Prizes in the past five years, both of them in fields related to my work over the past. I appreciate the Administration's commitment to funding the NIST labs, but I am concerned that the core funding hasn't fared that well over the past decade. I have several questions relating to that. Can you characterize the NIST labs performance and the value of the research? And what steps are you going to take to ensure that they continue to receive the financial support they deserve in the

coming years? And that includes not only the funds to do the research, but as you know, there are tremendous infrastructure difficulties, particularly at older labs. Another question relating to that is why is the Administration zeroing out ATP and MEP? And I am not getting into the issues of whether or not they should be funded, but the point is simply that the Senate will put funding in for them, and when you zero it out and they put the money back in, they take it out of other NIST functions, so in fact the research function of NIST will suffer as a result of your efforts to zero out ATP and MEP. Incidentally, I think MEP is a very good program. It should continue. The ATP, as you know, needs changes, but you did recommend those changes, and I would like to see them implemented and the program continue. But that is separate. The real question is why zero it out when you know it is going to be put back in and that money is going to come right out of the height of the research effort and the equipment and building budget. So those two questions.

Dr. BODMAN. Thank you, Congressman. First, as to the science mission of NIST, we are very enthused about it. Dr. Bement has provided outstanding leadership, in my judgment. And I believe that the increases I indicated during my presentation what—is one that in today's world, given the limited resources with which we are working, are reasonable and something that I believe will support the core mission of the laboratories. With respect to the infrastructure, the—I mentioned that as one of the important priorities in developing this budget, both at NIST and at NOAA, we have proposed in this budget substantial increases in the infrastructure of both agencies: some $79 million increase in NOAA and some $43 million increase in NIST. This would be for the repair of—with respect to NIST, which was your specific question, for the repair and maintenance, which is long overdue in the Bolder Laboratory. We are trying to do Nobel Prize quality research there in a building without central air conditioning, and we have got temperature swings of ten degrees or more in rooms where we are carrying out very meticulous work. And it just is an impossible feat. Secondly, we will be—we have also, in Gaithersburg, here in Maryland, have substantially old facilities there, too, and so we will be refurbishing some of the laboratory space that is being made available by the moving of our staff from current facilities into the AML [Advanced Measurement Laboratory]. So we are—believe that this is the first time, in recent memory, in any event, where we have seen a major commitment in this proposed budget of funding to improve our physical facilities.

In my two years in Washington, I have found it much easier to elicit support and enthusiasm, both in the Administration and, frankly, from Congress, on new programs, new ideas rather than fixing a physical facility that was built 20, 30, 40, or in some cases, 50 years ago. So we think we are starting down the path to do that. Coupled with that, sir, is a serious interest in the safety of our employees, and we have—we believe, with these investments, we will also start to be able to redress the—a much greater focus within the department on the safety of our personnel.

Lastly, with respect to ATP and MEP, in both instances, there are believers in these programs. These programs elicit the widest

range of variance of anything that I am responsible for. Some—we have, as I say, many, many people very enthused about it. Others don't believe that it is an appropriate function of government. Frankly, it didn't get down to a philosophical judgment; it got down to a judgment of limited resources, and we felt we were better off funding the priorities that I mentioned.

Mr. EHLERS. Mr. Chairman, if I may have ten seconds just to follow up, I very much appreciate what you have done in the NOAA and NIST budget. I am not questioning that. I am just warning you that by cutting the others, you may endanger what you really plan to do. And I hope we will have your help in that political battle.

Dr. BODMAN. We will work very hard. We really believe in this budget. And I think we have made some progress in terms of where we are putting our chips. And we will work very hard, sir, to try to sell it as best as we can.

Mr. EHLERS. I will pursue the rest of my questions in the second round. Thank you.

Mr. BARTLETT [presiding]. Thank you very much. The Chair now recognizes Mr. Hall.

Mr. HALL. Thank you, Mr. Chairman. Chairman, first, could I identify the three new members we have. I intended to do that in my opening statement. But new to this committee is Tim Bishop of New York and a very good addition. His background: he is a college provost, a college administrator, and has 29 years experience in education. And I think he is the one that made this his first priority, this committee. And I appreciate having him. I have Lincoln Davis, an unusual guy. He is a long-time Texas Senator from Tennessee. And all of us Texans are obligated to Tennessee, because if it weren't for Tennessee, we wouldn't have a Texas. A lot of people say they wouldn't have had one anyway if the Alamo had had a back door. He is heavy in agriculture, and a former mayor. His family lived next door to Sergeant York and acquired their holdings. I think you live on that property now, don't you? We are happy to have him. And we have Chris Bell of Texas. We have another good Texan on here from UT. He is on the Houston City Council, a big city councilman, and big in oil and gas and hospital and research facilities. Thank you, Mr. Chairman. I want to welcome them to this committee. And they are great additions, and we appreciate them.

I want to ask Mr. Card, we—now I notice your boat is loaded, too. You are charged with working on the Nation's high-level nuclear waste repository. I don't know how that is coming now, but we have suffered with that a long, long time. Clean Coal and FreedomCAR. Do you know Dr. John Mecada from the University of Texas? I have got some writings about coal—and the abundance of coal in the midsection—of coal in this country and how if we could develop it, we could double the total output of the OPEC nations all put together if we could use it. Texas has put scrubbers on theirs, and a lot of the mid-states have not. You worked on SPR [Strategic Petroleum Reserve] and that is of great interest to us. And that is kind of my—goes to my question today is—if I can find it. Yeah. Why are we reducing existing research and exploration for fossil fuels, particularly oil? And I am of an oil state. Texas is one of ten states that furnishes the industry, and I have the oil dis-

trict—I have the Oil Patch in my district. And you know, when our dependence on imported crude oil and refined products is growing by leaps and bounds and these products are coming from unstable parts of the world, the OPEC bunch of people over there that I referred to a little bit earlier, it—I don't understand when our dependence on them is—and then we are reducing existing research. Now we had some research in House Bill 4, I think, that died in the Senate, the deep water excavation and what else, yeah, just bring us up on that, if you would.

Mr. CARD. Sure. And let me just say that we—as you know, we did a program review last year. And what we are looking for is the sweet spot of what is really the appropriate role for Department of Energy and the research size, you know, for helping out, particularly the small producers, which are so important and I know are important to you. There—a package has been proposed for tax incentives and research and what is the appropriate balance between those. Our focus in our oil and gas program, in fact our—and extends to coal as well as working on the environmental aspects of it to make sure that we get access to the resources, because we see that as a continuing challenge. And so we are also looking at our portfolio to determine how important is drilling technology, for example, versus environmental issues with access. And so we have coupled that to look at low-impact exploration and development of oil fields and other similar work. But this year, we will be taking a harder look based on the PART score program that we—as you know, we used last year to guide our efforts on this to see how we can focus more on a long-term basis that research program and work on getting it back up to where I know you would like it to be.

Mr. HALL. What wartime powers—we have a President that understands oil and gas and a Vice-president that understands it. And they get criticized for that a lot, but I think it is the greatest—they can have a great impact on the future by their knowledge in the field of energy. And if we get into a war, I want to drill land more. And I want to—it is said I want to drill on cemetery lots if it would keep our grandkids out of a war. I am not that bad, but I am pretty close to it. But our Chairman here, the book on him is that I keep him from spending all of our money on saving the whales. Not this Chairman, but Chairman Boehlert. And he keeps me from drilling on cemetery lots. So there is an offset here.

But what wartime powers would the President have? I know he wants to drill on ANWR. Nineteen million acres up there, why we can't drill on a couple of thousand of them is beyond me. I don't understand. What wartime powers would he have if we do happen to get into a war that would turn us loose on that type of drilling, if you know?

Mr. CARD. Yeah, Congressman, to do justice on that, I really want—like to answer that one for the record. Of course, the Strategic Petroleum Reserve is the most obvious power that the President has. And the Administration continues to support increased exploration development in safer areas, as you talked about, more reliable areas in North America. So we will—if it is okay with you, I will respond for the record on that.

Mr. HALL. Okay. Are you going to do it in writing?

Mr. CARD. Yes.
Mr. HALL. Soon?
Mr. CARD. That would be my plan.
Mr. HALL. Okay. You better hurry. I told the President the other day when he came in to make his speech that if just two people went to Baghdad, I would be driving the Jeep for him. I want to ask Dr. Marburger one thing, and I thank you for your suggestion that you are going to answer our letter.

In January, Chairman Boehlert and I wrote to the President and—to commend him on his decision to extend the termination date for the President's Information Technology Advisory Committee, called PITAC. You are familiar with that, aren't you? And I don't—I am not among those that want to criticize the President, because I think highly of him, too highly probably, but no new members have been appointed to PITAC, and the Committee has not functioned now for more than a year. What is the deal on that?

Dr. MARBURGER. I have been concerned about that, too. We have been trying to identify new members that have appropriate technical qualifications so that that Committee can do its work properly. And I look forward to a very rapid replacement and filling of those vacant—vacancies on the Committee. And we are—this is very high on my personal agenda to get that done.

Mr. HALL. Get word to the Chairman and copy me with it and let us know what is happening on that, because we have a great interest in that. And I do thank you. I yield back my time. You have been very generous with your times. You make a good Chairman.

Mr. BARTLETT. Thank you. I appreciate that. Mr. Nethercut.

Mr. NETHERCUT. Thank you, Mr. Chairman. And ladies and gentlemen, I welcome you all and your staffs. I appreciate you being here and testifying today. I am amazed as I read through your testimony the breadth and the scope of scientific research and energy and development and technology and all of those broad range of subjects that—over which you have jurisdiction. It is, I think, very helpful to us to have a sense, and the American people, to have a sense of all of the good things that you are doing in the area of science. I appreciate you being here, Secretary Card, and I especially acknowledge you because of your Washington State roots, and I am glad you are all here. Dr. Bodman, you have a huge responsibility in an agency that is multifaceted and so important to not only American lives and interests but human health around the world. And so I congratulate all of you for your fine work and for your qualifications that you bring to this testimony.

Dr. Bodman, let me ask you about a little follow-up on Dr. Ehlers comments about NIST. I know that Congress established an important supporting role for NIST in the Help America Vote Act. And that legislation gives NIST the responsibility for developing technical standards for voting equipment. And I am wondering if you could advise the Committee to what extent NIST is ready to assume this responsibility, whether you are an advocate for securing more funding and maybe update us just a touch on that subject.

Dr. BODMAN. Congressman, the—as I understand it, NIST was authorized, but there was not funding available for that particular initiative at NIST. And we certainly have the technological skills

there to undertake and to perform the work that is required. But it is a matter of getting the funding that is required. The—when this initiative was put forth, we were most anxious that NIST be able—to be able to be used to set the standards, to set the technical standards and that there then be an interface outside of NIST, frankly, that would get into the political arena that would then find ways of implementing the standards and technologies that are developed there. We think the organization is there and in place and can function. It is a matter of getting the program funded.

Mr. NETHERCUT. I am informed that there is money in the Omnibus, and I guess the question is are you willing to work in next year's budget for additional assistance that would help implement the program?

Dr. BODMAN. I don't have a specific answer. We will have someone talk to you who can talk to you. Dr. Bement.

Chairman BOEHLERT. Would you please identify yourself for the record?

Dr. BEMENT. Yes. Dr. Bement, Director of NIST. I have personally been visiting with voting equipment companies. They have alerted me of their needs, and also, I am beginning to meet with state election officials. So we are beginning to set the stage for getting the Advisory Committee for the—Committee in place. It is my understanding that in the Senate mark, there was $500,000 for '03. Hopefully that will be in the Omnibus Bill. That will enable us to begin work on technical standards and to begin working with the election commission to establish the Advisory Committee for that that are required under that Act.

Mr. NETHERCUT. Thank you very much. Dr. Bodman, let me follow on with respect to your work with NOAA and the importance of that agency and the sub-agencies within NOAA. Let me talk with you about climate change, if I may, for a moment. I know that NOAA has been very involved in this—the international effort to address the issue of global climate change. Could you advise the Committee as to what the results of the December meeting were, what you expect to occur in the following year with respect to that important subject?

Dr. BODMAN. Yes, Congressman. First, for the record, there was a meeting held in early December, I believe December 5, that—it was over three days, 3, 4, and 5, I believe, that was chaired by Secretary Mahoney, who did an outstanding job. We had several members of the Cabinet, Dr. Marburger spoke, Dr. Colwell spoke, so we tapped into the science establishment, if you will, of the Federal Government. We also invited participants and interested observers from around the world. The—we started out with an expectation that we would have 400 or 500 people from around the world who would attend. We ended up with 1,300 participants in that meeting. It was regarded by most participants that I spoke to as a unique event. We had everyone from the United Nations. There were people from—I don't have the number, but scores of different countries were represented. And the idea was to have an outreach to solicit ideas, thoughts, and an evaluation of a program, a research program that had been described and was made available on the website of the Commerce Department of NOAA's website. There were then—we had a number of working groups, 30 or 40

of them, something like that. There were 225 invited participants to participate in each of those working groups. They all were there basically to provide input and criticism for the proposed research program. We are now in the process of editing that. We are taking—we were—we will—we have solicited response from the National Academy of Sciences to the program as well. And the goal is, this spring, to publish again on the website the response to this entire effort, which has been quite substantial. That will be augmented by the next global gathering, which is scheduled for July, this summer, which is an international meeting that we will schedule on global observations so that we could hopefully take the money that is in the '03 and '04 budgets that are intended to augment the department's efforts in monitoring both meteorology as well as the oceans and to get a collective effort of all of the nations of the world so that we can have something that will match up with the research programs that are being developed as a consequence of the December meeting. So we think we are moving. We are quite enthused about it, and we are very gratified by the extraordinary response that we have had from other nations and, frankly, from a very wide range of people in our country who hold a wide range of views on climate science. It is not difficult to find a wide range of views, I know.

Mr. NETHERCUT. I am sure.

Dr. BODMAN. But even on this committee we found a wide range of views, I remember last year.

Mr. NETHERCUT. I am sure. Well, I appreciate your testimony on the commitment of the President and your agency to this issue. Thank you.

Dr. BODMAN. Thank you.

Mr. NETHERCUT. Thank you, Chairman.

Chairman BOEHLERT. Thank you very much. Mr. Bell.

Mr. BELL. Thank you, Mr. Chairman. And I am—I know he has left the table, but I want to thank Mr. Hall for that kind introduction. I would also like to point out that I was brought on to the Science Committee to prove to the scientific community that not every man from Texas talks exactly like Mr. Hall. And as he pointed out, oil and gas is very important to Houston and to everyone in Texas, but I have always taken a strong stand against drilling on cemetery lots. The—so with that, I want to commend you all for your presentation. And thank you.

My question has to do specifically with funding for NSF. And Dr. Colwell and Dr. Marburger, perhaps you can both comment on it. Dr. Colwell, I believe you said that you are calling for a three—or a nine percent increase for funding. If our analysis is correct, it looks the Administration is calling for somewhere around a 3.5 percent increase. And more specifically, I am concerned about how that might impact projects, specifically in the area of nanotechnology. Rice University is located within the 25th Congressional District. And last January, they announced an agreement with IBM for a major nanotechnology project that will be funded in large part with NSF funds. I am curious how that type of project will be impacted if you do not receive the funding that you deem necessary. And also, overall, there seems to be a pretty wide disparity between the allocation of funds for the biomedical

sciences and for physical sciences and engineering. And will this imbalance of funding impact future plans and new innovations and advances in nanotechnology?

Dr. COLWELL. The—I would point out that the overall conclusion that I draw, really, from the budget is that the President is placing his full support and confidence in the National Science Foundation's mission and management, because he understands the NSF funded science is important. Clearly, we prepared our budget not knowing what the final appropriation would be for fiscal year 2003. But nevertheless, the increase that we got was more than doubled the rate of increase for the entire rest of the Federal Government's discretionary accounts. So when you consider the fact that $76 million in program transfers are not being reproposed, the actual entries for NSF is more like 11 percent over last year's level, which is nearly triple the amount of increase for the entire rest of the government's discretionary accounts. It is a notable increase.

Now your comments address nanotechnology. Nanotechnology is clearly one of the major initiatives for the National Science Foundation, and it will continue to be addressed with funding. I do know that Richard Smalley is from your state, and he has been one of the major contributors to nanotechnology and the basic concepts. So I would assure you that nanotechnology will remain a priority and will certainly be at the top of our list. And I would suggest that Dr. Marburger may want to comment.

Dr. MARBURGER. Yes, I would like to mention that because nanotechnology is a national priority, it received greater than the average amount of the increase that was proposed for NSF. According to our numbers from the budget, compared with the '03 request, nanotechnology within NSF would go up almost 13 percent as compared with the nine percent overall.

Mr. BELL. Is that sufficient based on the request and the various efforts going around—going on across the Nation to move nanotechnology forward, Dr. Colwell, in your opinion?

Dr. COLWELL. I think that considering that the total budget is approximately that which is being invested by Japan in nanotechnology that we should not do less. We need to maintain the level that we are at.

Mr. BELL. Thank you.

Dr. COLWELL. Also, you pointed out the concern about math and physical sciences. I am truly delighted that we will have in this budget over a billion dollars for the math and physical sciences, the largest increase in the research area for the mathematics, physics, material science, chemistry. These are very, very important areas that seed the advances in the applications of energy, medicine, etcetera.

Mr. BELL. Thank you, Mr. Chairman.

Chairman BOEHLERT. Thank you very much. Dr. Burgess.

Dr. BURGESS. A question for Dr. Bodman: the Committee has been concerned about the problems that NOAA has had with delivering satellite data products to weather forecasters and archiving the satellite data. Like Mr. Hall and Mr. Bell, I am from Texas as well, and we are always concerned about the weather and your ability to forecast it down in Texas. But additionally, we are concerned about how NOAA will manage the tremendous increase in

weather data that is on the way and what plans specifically does NOAA have to address these critical issues?

Dr. BODMAN. Well, as the Congressman, no doubt, is aware, there are new satellites that are being designed and that are coming into use. NOAA has devoted first resources within NOAA so that we can put that information to best use within the weather service. That—with the new information, also, it is being—that the software is being developed and approaches are being developed within the Defense Department who shares the information that comes out of these satellites. In addition to that, we have an ongoing program for upgrading the Radar, the so-called NEXRAD system, that are installed on ground. And so the challenge will be to integrate these—the new technologies that are available with respect to the Radar—the advancement of the technologies in various Radar installations and integrate that with the satellite system. All of that is included as a portion of the—of this '04 budget.

Dr. BURGESS. And then just a follow-up to that, the ability to archive the satellite data for critical research purposes, do you feel comfortable with your ability there?

Dr. BODMAN. We believe that we will be able to archive the data and have that available for future research; yes, sir.

Dr. BURGESS. Thank you, Mr. Chairman.

Chairman BOEHLERT. Dr. Bodman, I want you to know you—NOAA's got a new fan, the weather service. On a recent visit with some of your key people, I learned about something that I think every American should know about. For 25 or 30 bucks, you can go down to Radio Shack or some place and buy this little radio. You can bring it home, and you sit it there, and it self-activates when you want to get—when there is an emergency weather warning from the National Weather Service. I mean, it can sit there and never has to do anything but sit there and maybe collect a little dust, so when I help with the housecleaning, I have to dust it. But it is just marvelous, and I was not aware that that existed. And it can be programmed in your local area, so that at any given moment, you just press the button, and it gives you an instant weather report. But the thing that—and I think this has homeland security implications incidentally, and I am talking with the people over there because the new Under Secretary for Science and Technology that this committee helped create for the Department of Homeland Security, I want to make sure he knows all about this. But I would hope that your staff could get some more information on that capability to all of us, because I think every Member of Congress should put it in his or her newsletter. And I bet you down in Texas, Dr. Burgess, most of your people already have one of these instruments.

Dr. BURGESS. Yes, sir. That is correct. And of course, Radio Shack is a good Texas company.

Chairman BOEHLERT. Well, that is why I thought I would give them a part, too. But——

Dr. BODMAN. Chairman—oh, excuse me, sir.

Chairman BOEHLERT. Please, respond.

Dr. BODMAN. I was just going to make a comment. First, I am very pleased that you are enthused about the product. Secondly, I can tell you as a user of the product, you have to be careful that

at 11 o'clock on Wednesday, if it is sitting there on your desk collecting dust, they put out a test signal once a week. And so you can be interrupted in whatever you are doing, so you should be prepared for that.

Chairman BOEHLERT. Well, we are all about it anyway, so we are always alert.

Dr. BODMAN. Well, this helps reinforce that, and I would also comment to you that within the '04 budget that has been proposed to this committee, is $5.5 million for the upgrade of the NOAA weather radio system such that it can be used for a much wider variety of emergencies, namely that we have many people throughout the country that have been using these devices for some time. They are used to it. People who—farmers, in particular, whose livelihood depend on the weather, and therefore, there is a user group. And we hope to be able to tap into people who are already used to this system and then finding new converts, like yourself, that we can use this system for any kind of national emergency, other than just weather. And so that is in the budget, and we would hope for your support on that.

Chairman BOEHLERT. Well, I wouldn't describe me as a convert, because I didn't know a darn thing about it. I am just enlightened now, and that is one of the benefits for Members of Congress to get out from behind their desk or out from behind the podium like this and go out and visit and learn from the people in the field. But I have to believe that every school in America should have one, that capability, every hospital in America, and quite frankly, I think every home in America. And we are not talking about a major investment. And it is not something Uncle Sam is going to pay for and just start distributing all of these, but there should be a program.

Dr. BODMAN. Well, in response to your request, we will certainly do our best to make sure that every member of the Committee has appropriate information on the device so that if there are those members who wish to include that in their newsletters to their constituents, we would be most appreciative. NOAA does—really, it is a home of great science. I would tell you, sir, however marketing is not yet our strong suit. We are working on that. And we could use some help, and if members of the Committee would help us, we could use it.

Chairman BOEHLERT. We will do our best. And the newsletter is a nice vehicle, but I am working with my staff people to try to find some way to—that we can come up with some resources. And I don't know if they are government or foundation or donation, but I want to make sure that every school and every hospital and every place where there is a concentration of people in my district have one of these. And I want to make certain that every one of the people I am privileged to represent is aware of their availability and their capability. I mean, there are so many applications that—well, enough said about that. Mark that down that I gave a plug to—a couple of plugs to Texas. Mr. Davis.

Mr. DAVIS. Well, it is certainly good to be on the Committee. I represent an area that from time to time—we talk about Silicon Valley being, I guess, a technology quarter. But we have Oak Ridge, Arnold Engineering Center and just south of us in Bud

Cramer's district is Marshall Space Institute. So we—my district is composed of many different agencies and organizations that really have been a major part of technology and the advancement of technology. The research certainly at Oak Ridge, the wind tunnels at Arnold Engineering Center have—it has been a major part of our national defense, testing basically every military plane that has flown today.

It is good to be on the Committee. I didn't realize I was going to be up to talk, so—but it is certainly good to be here, and I look forward to learning and listening as this committee advances into hearings in the future.

Chairman BOEHLERT. Thank you very much. And our next elevated member of the panel, the new Subcommittee Chairman for the Subcommittee on Energy, the distinguished gentlelady from Illinois, Ms. Biggert.

Ms. BIGGERT. Thank you very much, Mr. Chairman, and it is nice to be with all of you again. And I—but unfortunately, I always come with this—the same thing, and I hope it—that we can solve this problem so I won't become a broken record all of the time.

I am extremely disappointed in the overall budget proposed for DOE's Office of Science. I am really puzzled why this happens, because it is the government's largest supporter of the physical sciences, the DOE's Office of Science. And in many cases, it is the only supporter of certain physical science disciplines, like fusion energy science, heavy element chemistry, catalysis high-energy physics, and nuclear physics. And I do have a bill, H.R. 34, which I introduced last year and reintroduced this year very early on. It means so much to me, H.R. 34, so I would hope that you would take a look at it. And it really does propose increasing of the funding for DOE Office of Science, 60 percent in four years. And I know the NSF and, Dr. Colwell, you do a great job, but we just need this other element, too, and I think just a little more parity. And I think just to say that the Spallation Neutron Source is being reduced, so there really is more money. And that can—that goes on in every agency, but when you really limit, you know, the increase to such a small amount, it really is flat funding.

And one question I wanted to ask for Mr. Card just in the short time that—in—the President announced in June of 2001 a new Climate Change Science Initiative, which has already reviewed the entire federal climate science portfolio and produced a draft plan for focusing the government's efforts in this area and to guide the future climate research. And then on the same day, the President announced a similar initiative for climate change technology. And I don't—and unfortunately, I don't think the DOE has made public a review and has not published any draft plan. Will DOE produce such a plan this year in time to influence—well, it would have to be the fiscal year 2005 budget now, I suppose, unless there is something that I haven't seen in the fiscal year 2004. And does that involve outside scientists and stakeholders just as NOAA has done in shaping the climate science plan?

Mr. CARD. Well, first of all, it is DOE's hope to be able to produce a plan this year. I want to assure you that the lack of a published plan is not resulted in a lack of planning or activity. So as I announced in my written testimony and in the oral testimony, there

is really quite dramatic re-prioritization and shifts going on to address the issue and a strong interagency effort. The programs have substantially different origins, which explains the relative difficulty of organization. The science program, of course, started ten years ago and has had time to work things out. And also, as you saw from Dr. Bodman's chart of funding, is really evenly distributed amongst many agencies, including the Department of Energy, whereas in the technology program, Department of Energy is the overwhelming contributor of about 90 percent of the funds at this point. And so figuring out how to organize that, which we have done now, and we just announced a new full-time director of that program to keep pace with the excellent work of Dr. Mahoney at Commerce.

And so we have a high degree of confidence that we will be able to get alignment within the Administration to issue a report this year.

Ms. BIGGERT. So it should be by the end of this year or——

Mr. CARD. I would hope by—I'll go out on a limb here and say I hope certainly by summertime that it will be out.

Ms. BIGGERT. Thank you. Thank you, Mr. Chairman.

Chairman BOEHLERT. Thank you very much. Mr. Costello.

Mr. COSTELLO. Mr. Chairman, thank you, and I thank the witnesses for being here today. Dr. Bodman, let me ask you a little bit about the wind profile network operated by NOAA. The Administration's budget request for '04 retires that system. And as you know, the NOAA wind profiler network is the only one of its kind. It was instrumental in helping NASA track the debris of the path of the Columbia Space Shuttle and is also used by the National Weather Service, the Department of Energy, the Department of Defense, Department of Transportation, private meteorologists, and a number of people in the private sector in weather forecasting tornadoes, thunderstorms, and things of that nature. I am wondering why the Administration is terminating this program.

Dr. BODMAN. I don't have a quick answer. I am going to ask the—Admiral Lautenbacher to speak to it in a minute. I will just tell you that we continue to make investments, propose investments, which are in the budget, as I mentioned before, in new Radar systems, in new satellite technology that will enable us to do a much better and increasingly good job with continuous improvement over time of forecasting the kinds of weather events that you describe. What the wind profiler effort is, I frankly don't know, but let me ask the Admiral.

Admiral LAUTENBACHER. I'm Conrad Lautenbacher, Under Secretary of Commerce, Administrator of NOAA. Thank you very much, sir. The wind profiler, as many of you are aware, was a research and development program. It has been going on a number of years, and it has basically reached maturity. We had some very hard decisions to make given the budget constraints that we had. I asked all of our laboratories to look very hard at programs that have been going on for quite a while that had not become useful operational tools. In other words, that they would progress from research into our 24/7 weather forecasting, environmental forecasting, management of coastal zones, etcetera. This program has been a great tool in the research area, but it did not turn out to

be cost-effective in terms of integrated it into our normal 24/7 forecasting system. So in a very difficult budget area, we had to slow down the development of the program, so it has very little funding attached to it at this point. It doesn't mean that it doesn't have some value for various parts of our country, but when we looked at it in terms of our overall budget, that is the decision that was made.

Mr. COSTELLO. Did the system, the wind profiler network, in fact, help NASA track the debris for the Columbia Space Shuttle?

Admiral LAUTENBACHER. The data was useful. And NASA asked us for every piece of data that we could find. And we took every system we had, whether it was in research, operations, satellites, our Radar systems, and our computational capability and gave them everything we could. The data from the Radar profiler system was offered to them.

Mr. COSTELLO. And the cost of operating the system annually is——

Admiral LAUTENBACHER. About four to five million dollars a year.

Mr. COSTELLO. And how much will it cost to shut the system down?

Admiral LAUTENBACHER. Well, there is a varying estimate to that, but it will probably phase out at about—it will probably be three to four million dollars to shut it down over a period of time.

Mr. COSTELLO. And when—obviously these are difficult budget times, we have to make decisions, you—your people analyzed, as you said, this research and development project. I wonder if you might submit to us, to the Committee, the analysis that was done by your staff in making this determination.

Admiral LAUTENBACHER. Absolutely. We would be pleased to.

Mr. COSTELLO. And a final question on the wind profiler network, we realize that the budget includes money to expand the capability of NEXRAD, but it is two different systems, as I understand it. And it would seem to me that NEXRAD complements the wind profiler system, and I would just ask that you take that into consideration, and your staff as well.

Admiral LAUTENBACHER. Yes, sir. I appreciate your interest. We will certainly continue to look at it.

Mr. COSTELLO. And a final question. Mr. Card, I appreciated the comments made by Mr. Hall from Texas about coal, and I want you to know that we have an abundance of coal in the center of this country and a lot of it in southwestern and southern Illinois, so I will be talking to you about clean coal research and things of that nature. But I have a question concerning the self-regulation. As you know, for many years this committee and others had proposed that we go to an external regulation as opposed to self-regulation of occupational health and safety issues at our nuclear facilities and civilian DOE labs. And I just wonder where we are in that effort to come up with external regulation as opposed to continuing to self-regulate the industry and the business.

Mr. CARD. Where we are today is Congress has taken control of that process and directed the Department of Energy to cease and desist on studies or other aspects of self-regulation until we are—we promulgate an internal regulation dealing with occupational

safety. And that was in the Defense Authorization Act. So we are busy trying to get that done. Right now the forecast is the end of this year on an expedited schedule to get that done. And when that is done or we get other direction from the Congress, we look forward to resuming our look at self-regulation.

Mr. COSTELLO. And if the Congress tells the Office of Science to implement external regulation, how long would it take to get a program up and running of external regulations?

Mr. CARD. It really depends on the facility. The—just quickly, some of the issues in self-regulation are—would primarily involve OSHA and the Nuclear Regulatory Commission as how are those programs implemented at our laboratory sites. So as we were studying this, before we were told to stop, we were analyzing, for example, at our Berkley lab, I believe it is the city of Berkley, has the OSHA enforcement authority. And the question is as competent as the city is, they are not used to regulating that kind of a facility. So we were looking how can we establish MOUs with OSHA and the states on who is going to be the regulator.

Then there were other legacy issues. Some of our facilities, you know, are quite old. And we have some, like Thomas Jefferson Laboratory here in Virginia, that are new. And so the thinking we were on at the time that we stopped was to begin with the simpler new facilities in states with the more straightforward regulatory approach from an NRC and OSHA perspective and move on from there.

Chairman BOEHLERT. Thank you very much. Dr. Bartlett.

Dr. BARTLETT. Thank you very much. Mr. Chairman, I noted with appreciation the modest increases in funding for basic research. But I would like to note that the funding is still far from adequate. It is a truism, I think, that not adequately funding basic research is analogous to the farmer eating his seed corn. If you do not plant, you will not harvest. And if the harvest is engineering applications, which fuel our economy and support our military, then the planting is certainly basic research. And our inadequate funding of basic research for the short-term puts at risk our economic superiority in the world. In longer term, it will put at risk our military superiority. We have got to correct the under-funding of basic research.

I would just like to make a comment or two on oil. We are one person out of 22 in the world. We use 25 percent of the world's oil. We have two percent of the known reserves of oil in the world. There are about 1,000 giga-barrels, and this is a generally agreed on number, 1,000 giga-barrels of oil in the world. You divide into that our 20 million barrels a day and the world's 60 million barrels a day, you come out with roughly 40 years of known reserves of known reserves of oil in the world. We will certainly find more oil, but we would certainly like to use more oil. And our third world countries would like to do for their people what we have done for our people to industrialize and improve their quality of life.

And we will be very lucky, Mr. Chairman, if the oil we find matches the additional oil we would like to use. I think the reasonable assumption is the world has about 40 years of known reserves of oil in the world, and that is about what is available there. Every year, since 1970, with a tiny blip for Prudeau Bay we have found

less oil and pumped less oil in this country. In 1982, we spent more energy looking for oil than we will ever get from the oil that we found in 1982. I am opposed to drilling in ANWR and under Lake Michigan and off the coast of Florida, not for any environmental reasons, although there may be environmental argument. I am opposed because if you use 25 percent of the world's oil and import 56 or 57 percent of what you use, I don't think it makes any sense to rush out and pump that measly two percent reserves that you have. This may be a rainy day. I think there is going to be a rainier day, and I would like to husband those meager reserves we have for a more difficult time in the future.

I have two questions relative to these comments. First, how do we go about getting an understanding of the importance of basic research and more money for basic research? And secondly, how do we educate our public and our public officials so that they understand the energy challenges that we face in the future? We are not going to drill our way out of this. By the way, I think the world has drilled about four million oil wells. We have drilled three million of them in this country. There is a reasonable agreement by a number of experts that no matter how feverishly we drill in those few known reserves that we yet have, that we will not increase oil production in this country. It will continue to go down. Certainly, it will not go down at as fast a rate if we are drilling in our oil reserves, but the general consensus is that it probably will continue going down. We desperately need more research and alternatives. We need to free ourselves for economic reasons, for political reasons from foreign oil. How can we educate our public and our public officials so that we can have the appropriate emphasis on this?

Dr. MARBURGER. I guess I answer questions like that, Congressman. I think the activities of this committee are very important in educating Congress and the American public. I have been impressed with the pointedness with which these questions have been raised in this committee, and I have also been impressed with the response. We certainly try to respond, in my office, to direction from this committee. And I believe that time and again, you have emphasized important strains and important aspects of the Nation's need for science.

This budget comes in a time when the economy is weak, recovering slowly, when there are other national priorities for national defense and homeland security. And there has been a real effort to prioritize, based, to a great extent, on priorities that have been identified in hearings that this committee has sponsored. And that is why, as you look through this budget, the details really do tell a story of commitment to basic research and to funding those priority areas even when funds are short. So if you look at the funding for priorities that this Administration has identified, you will find over and over again very substantial increases in nanotechnology. And even in the Office of Science, for example, the amounts of increased money that are invested in nanotechnology are very, very substantial. National Science Foundation, not every program gets increased, but those that are most important do. So I think if we continue to work together like this, identify priorities and then, as the funds become available, it is important for Congress to pass the

budgets and fund the requests. It—and I think we can make progress that way.

Chairman BOEHLERT. Thank you very much. Mr. Smith.

Mr. SMITH. Thank you, Mr. Chairman. Dr. Bartlett, if basic research is the seed corn, it would seem to me that maybe the germination for that seed corn might be the researchers and the scientists that leads us to where we go in encouraging more individuals in the K through 12th grade to be interested in math and science, where we go in terms of doing better jobs at our colleges and universities. You know, I think there is good news and bad news in this budget. The President's budget for the National Science Foundation, our basic research institution, is nine percent above what the Administration requested last year. That is the good news. However, right now, we are writing into the Omnibus Appropriation Bill, an 11 percent increase of where we were over '02. And that means that the Administration's request comes down to a 3.2 percent increase over the bill that we are going to pass this afternoon. And compared to our National Science Foundation Authorization Bill, that means it is going to be approximately 14 percent below the authorized level that the President signed into law on the 19th of December.

I think we are in a new era of challenges from terrorism to where we go on protecting our national security. That means that all spending has to be reviewed and I think a greater challenge to the research community in trying to make sure that, if you will, the taxpayer gets a greater bang for their dollar that they are investing in research. To me, Rita, I think part of that means that we have got to do a better job in tech transfer. We have got to look at ways where we can maybe encourage the business private community to cooperate and invest more with our research, basic research community. And if you are going to end up in encouraging that kind of a partnership, then it has got to be a win/win proposition where we win in terms of expanded research, where business wins in terms of some greater ownership of what might result from that basic research as far as licensing or as far as property rights. I commend you, Dr. Colwell, for beginning to meet several of the requirements of the NSF Authorization Bill, including those provisions related to the major research equipment account. And I am certainly interested in working with NSF to see that several of our other Committee priorities come to fruition, such as the plant genome and gene expression centers and the centers for research on learning and math and science.

Regarding the major equipment account, I was pleased that you have some prioritization in terms of the listing and regarding the breakdown between directorates, but still, it is not all there. I have not seen language describing the criteria used to develop the list nor a description of the major factors for each project that determines its ranking on the list. And this information is required to be annually submitted to Congress prior to any budget appropriations, so maybe, Dr. Colwell, start with bringing us up-to-date on that MRE account.

Dr. COLWELL. If I may, I would like to comment very briefly on your other points, because they are so very important. We have been focusing on management, and we have, as you know, the only

green lights in the entire Federal Government for financial management and for e-business. And we are working very, very hard on human resource and the other of the President's management agenda, because that is one way to make sure that we spend the money wisely for the taxpayer.

Secondly, education is absolutely critical, which is why we have focused on the GK–12, bringing graduate students into the K–12 classroom to bring the excitement. And we have focused on the science of learning centers that you also referred to.

With respect to tech transfer, we do have an increase in the budget requested for Partnerships and Innovation, because that is to work with communities to—for economic development of just the sort that you have been describing.

With respect to the management of our large facility projects, we have had a very successful record of providing state-of-the-art facilities for science and engineering research. And we have taken several steps already to ensure that the policies and practices will continue to serve the scientific community and the Nation well. We have provided more formal guidance in ground policy manuals for handling the research construction funds. We have completed our very large facility projects management and oversight plan that outlines the goals and strategies for integrating current procedures into the next generation of facility projects. We have established——

Chairman BOEHLERT. You have done great work, but our time is getting short.

Dr. COLWELL. Okay.

Chairman BOEHLERT. And you have got to catch your plane pretty soon.

Mr. SMITH. Just a quick comment on making the MRE more transparent and helping to go along with what we have suggested in the bill.

Chairman BOEHLERT. Thank you very much. And now, a very patient Dr. Gingrey.

Dr. GINGREY. Thank you, Mr. Chairman. I am convinced that I got put on this committee so that an M.D. would be forced to see what a real doctor really looked like. And I have been very, very impressed with the testimony. And it is—I look forward to working on the Committee and working—let me ask just a very brief question to Mr. Card.

Mr. Card, recently, the Department of Energy discontinued the funding for the PubSCIENCE on your website. This service provided access to abstracts of a wide range of scientific publications with links to available sources of information. And we feel—I feel this was an invaluable tool for science teachers around the country. And I understand that there are some alternative sources available, but they are either too expensive or provide much less information than what was being provided under PubSCIENCE. Is this an issue that DOE would be willing to take another look at to either urge the commercial services to provide more information to the public school teachers or possibly to consider restoring PUB service—PubSCIENCE?

Mr. CARD. Well, we are always willing to reevaluate decisions made that—the PubSCIENCE decision was a difficult one. We

agreed that it was a successful undertaking. However, we also believe that we shouldn't be competing with the private sector. And it was felt that for the core purpose of PubSCIENCE that there were viable alternatives out there. We would certainly be delighted to help look for ways that we might be able to supplement that, if the Committee would like to see how we can help the private sector solution work better. But that—and again, in challenging budget times, we concluded that it was best to give the private sector a full crack at that and see how it would work out.

Dr. GINGREY. But you would be willing to relook at that and to work with the private sector in trying to make sure that the services they provide are comparable to what our teachers were getting with the PubSCIENCE——

Mr. CARD. Certainly. I will respond for the record on that question.

Dr. GINGREY. Thank you, Mr. Card.

Chairman BOEHLERT. Thank you very much. Here is how we are going to wrap up. I have just got two quick questions for Dr. Marburger and Dr. Colwell on one of my favorite subjects, cyber security. And then we will go to Dr. Ehlers for a summation, because I have to go to another commitment.

Dr. Marburger, I didn't see anything in the proposed budget for '04 for the Department of Homeland Security [DHS] for cyber security. Is that something that is going to be a little bit slower in getting started up? I mean, it is one of my passions, and I know it is a passion that you share. And we have to deal with it. It is very real.

Dr. MARBURGER. Yeah, cyber security is essential. It is important for us to have a sustained research program in this area. The important thing to note with respect to activity in the Department of Homeland Security is that there are many other places, many other federal agencies that are funding research in this area. And it is important to determine what the domain will be within DHS. That is the major issue, I would say.

Chairman BOEHLERT. Not as many as we would like and not as much as we would like. And that is one of the things we discovered when we developed this whole proposal, and that is why I am so glad the President signed their legislation, because it was all over the place about $60 million and a little bit here and a little bit there. And nobody was really doing their job, which brings me to Dr. Colwell.

Dr. COLWELL. Yes.

Chairman BOEHLERT. As we have given the job to you, and we have made NSF the lead agency. And we have $105 million authorized, yet only $35 million requested. Is that sufficient to get us going where we need to go?

Dr. COLWELL. Well, let me just say that right now, we are—we have the federal cyberservice scholarships. We—the research in the CISE directorate, the trusted computer program—trusted computing program, that is about $80 million in requests. And we have got 140 proposals, and we only have about $5 million in '02. And it is slated to grow. On network security, the funding is roughly around $4 million. And middleware security is another important area. We have requested an additional $20 million for these pro-

grams in cyber security. Clearly, this is an area that we really have to emphasize. And the funding that we asked for is critical. I laud your support and your interest, because it is probably one of the most important things we can do as a nation.

Chairman BOEHLERT. No question about it. When we were talking about cyber security two years ago, and we experienced this. We brought up the subject. It drew muffled yawns. After 9/11——

Dr. COLWELL. Yes.

Chairman BOEHLERT [continuing]. We got their attention. And this is part of the dilemma people in your positions face. We just had the previous questioner talking about PubSCIENCE, which is unquestionably very valuable. It is a great resource for our young people and our schools, but to equate, for example, PubSCIENCE with the cyber security on a priority scale, I don't think there is any doubt in anyone's mind. What we would like to have is both, but we have got some difficult choices to make. I just want to make sure from Dr. Marburger and to you, Dr. Colwell, because of the responsibility we placed on your shoulders to be the lead agency to deal with this, that we really are very serious in dealing with it, because we are talking about very serious business. Thank you very much.

Dr. COLWELL. May I make one comment, Mr. Chairman, because I would like to point out that September 1, 2001, the National Science Foundation announced a cyber security program. That was a week before September 11.

Chairman BOEHLERT. Thank you very much. Keep it up. Dr. Ehlers.

Mr. EHLERS. Mr. Chairman, while you are moving over to the Chair, may I just request that NSF submit for the record the criteria that you are using for the MREs?

Dr. COLWELL. We will, sir.

Chairman BOEHLERT. Yes. And all of the witnesses should know, the customary practice, there may be some additional questions from the panel that would be submitted in writing, and we would obviously appreciate timely and complete responses. Dr. Ehlers will take the Chair. The Committee is his.

Mr. EHLERS [presiding]. Now that I am in charge, this could go on for a few more hours. Actually, I have a 12:15 meeting, so it won't be that long. I would like to follow up on a few issues that were raised, first a few relatively minor ones. On the radios that the Chairman referred to, I also wanted to announce, and you can market this, there is a radio with a crank on the back, which brings us back about 50 years, but it is incredibly valuable during tornadoes and other activities when you—your batteries might run out, so I want to mention that.

Also, something else you should publicize, Dr. Bodman, Dr. Bement, is the new clocks and even wristwatches tied to the time standard. I have one in my office here, and that is why I was the only member on time here today. It is accurate to a millionth of a second or better. So keep up the good work, and we will do what we can to publicize it.

On a more serious note, tying together comments of Ms. Biggert, Dr. Bartlett, and Mr. Smith, they reflect a trend. Congress is often accused of not thinking past the next election. Presidents are often

accused of the same thing. That is not really fair. We do much better than that. But there is that tendency. And we have a lot of brainpower represented here on this panel and the agencies you represent. It is very important that in the field of science, with the ability you have, you represent the long-term planning horizon, which this country needs. I have been cursed throughout my entire life with long-term planning horizons. I think they are absolutely essential, but that does handicap one in Congress at times. But this has to be done. The issue, for example, of energy supply.

It is very easy to say, "Well, we have enough oil. Why should we worry about it?" You know, "All we worry about is the price at the pump." But if you look at the long-term picture, our nation has huge problems, and that is why the Hydrogen Initiative and other things are so important. The increased amount of money of research, it is not just a matter of seed corn. And I will get to some questions, but I have to do some editorializing first. It is not just a matter of seed corn. That is very important. But again, the long-term picture, as Dr. Smith—Mr. Smith mentioned about the educational aspects of it. And I have devoted most of my life to that and my life in Congress as well. We have to do it. The—we are worried about our national security now. Billions upon billions of dollars are being poured into our defense, both homeland and at our Defense Department. And yet, a small portion of that spent in your areas is going to add more to our national security for the long term than the short-term events we are dealing with this year in homeland security and in our Defense Department. So we have to unite. I will certainly do my part in the Congress, as I have tried to do. You are going to have to carry the load in the administration on some of these issues and some of this thinking.

On a few specific things, I mentioned earlier the doubling of the NSF. It is—my efforts are going to be in doubling the research portion of the budget in all of your agencies and other agencies besides. Ms. Biggert has a bill in to double the DOE research effort. And I am a strong supporter of that and will be working on that. And Mr. Card, I think it is essential that the research effort in your department get the priority it deserves. I will also argue against cutting of PubSCIENCE simply because that is a great way of educating the public about what you do. And NASA has been a genius in educating the public over the Internet and getting political support. I find across the country, there is not much political support for DOE. And the more you do in that direction, the better.

Just a few specific questions to wrap up, and if you want to give any response to my comments, you are welcome to. But I am going to depend on you to try and gauge in this long-term planning that we desperately need.

Mr. Card, you mentioned the hydrogen program. And I am totally in favor of that. I wish we had started 10 years before, and that is where the long-term part comes in again. We are behind the eight ball. But at the same time, I am a little worried about calling it the hydrogen program, because there are other options out there in terms of fuel cells, which may prove to be better than hydrogen, but we just haven't done the complete research on it yet. And so I urge you to go into this with an open mind. There are a lot of problems remaining with hydrogen. Right now, it looks very good,

but huge infrastructure problems that have to be addressed if this is going to work. That includes where do we get the supply of hydrogen. If we get it from petroleum, we haven't solved our dependency problem. We haven't solved the climate change problem. So we have to look at alternatives there. Where are the people going to get the hydrogen? Corner service stations are going to have to be completely change. The oil supply mechanism has to be effective. So there are huge infrastructure problems.

And if you look at all of that, as well as the science, you may find other alternatives that are better. I can't guarantee it. I am just saying they have to be looked at. So think seriously about that as you enter that program.

Mr. Bodman, a specific question, I am concerned about the NOAA satellite program, and I recognize the increase in NOAA. You have been quite generous, but there is a huge expense coming forward in the NOAA satellite program that has to be done right, because that is going to determine the data we receive for the next decade or two. And so I question specifically on that. Are you sure there is enough money there to deal not just for the research responsibilities of NOAA but also the satellite program and to totally and properly manage that in a way that is going to produce the results we are going to need for the next two decades?

And Dr. Colwell, I know you have a plane to catch. If you have to leave at any time, feel free to walk out.

Dr. COLWELL. Thank you very much.

Mr. EHLERS. We don't shoot the witnesses in this committee.

Dr. COLWELL. Thank you.

Dr. BODMAN. With respect to the satellite program, we have done our best, Congressman Ehlers, to make judgments as to the survivability of the current satellites that are there, both the so-called POESS satellites as well as the GOES satellites, the polar orbiting ones and the geo—stationery ones. And the challenge is to make sure that we are spending money at a rate years in advance. The next satellite will be launched in 2009, and the next GOES satellite is scheduled for the year 2012, at least these new systems that we are putting in, it is 2012. So we are starting to—this budget contains funding for both. During this past year and August of last year, we have signed a contract for the POESS satellite, and we are, I would say, comfortable that we have sufficient funding and the sufficient commitment to this to get this job done, provided that we don't have more slippage. When you have something that is being funded today that is not due to be launched until six years from now or 10 years from now, there is always a tendency on the part of those who are examining the budget, "Well, what difference would it make if you just slip it another year?" And frankly, we—at least in my judgment, I think we are in a satisfactory position today, I would describe it to you.

But I don't think we have a lot of room for error in further slippage in funding in the years ahead. And so I think I am comfortable to come to you with this budget that we will be able to get the job done or our successors will be able to get the job done eight and 10 years from now. But we will not be able to, even in tight times, reduce these budgets in the years out that will be required to get the job done.

Mr. EHLERS. Thank you. And I encourage that I am particularly concerned about additional expenses coming along or inadequate funding, because we have to go forward on it, and that will hurt your—the rest of your research program, because you are going to have to take that money to put into a satellite program.

Mr. Smith wanted 60 seconds for a question, and then we will go back to the panel.

Mr. SMITH. Wouldn't it be nice, Mr. Ehlers, if Michigan, you, and I could just keep these four witnesses and just get everything out of them and also relay to them some of our interests? Dr. Marburger, yesterday, of course, we met with Administrator O'Keefe. How was the—and I have got—had two kids that worked with the JPL. They have been trying to convince me over the last 10 years that unmanned space flight, for 90 percent of the research would be much more effective and efficient. How is the Administration going to proceed to evaluate the right balance between manned and unmanned space flight, and how much of that research could be done on the ground in terms of a tight budget that we are looking at and a greater effectiveness for our effort?

Dr. MARBURGER. Well, I can't give you a ratio off the top of my head, but that is certainly an important factor of NASA planning is to find an appropriate balance and appropriate roles for manned and unmanned research. We do both of them now. There certainly is going to continue to be review of the long-range plan for space exploration. There is an appropriate role for humans in space. It is a hazardous environment. We have to make sure that the missions that humans are involved in are best possible—they take the best possible use of these very important missions. And I believe that there is a planning mechanism in place. NASA is doing that. We are watching it. But as far as giving details at this point, I think that is premature.

Mr. SMITH. Just in conclusion, Mr. Chairman, thank you. NASA is somewhat biased, it would seem to me. It seems to me that the science community must be part of the kind of information that is needed to get the right balance.

Dr. MARBURGER. That is true. And they do have access to external expertise.

Mr. EHLERS. Thank you, Mr. Smith. Just a minute or two if any of you wish to comment on my earlier statements, I would be happy to entertain those. Mr. Card, you look like——

Mr. CARD. Sure. Well, I would just like to say and give greetings to both of you from your Michigan colleague, Secretary Abraham. And I certainly hope the Committee recognizes the—that the hydrogen program, and I accept your comments that we don't want a central planning exercise. And certainly the program is designed to allow industry to help direct us where we want to go with the program. But it represents a major acknowledgment and commitment to our future energy supply. And I just want to call attention again to the Committee that the oil issue is why you are seeing a hydrogen program and coal and nuclear and renewables and the other energy sources. So when the President announced the program, both in the State of the Union and later last week, he recognized that between that and the ITER program was an acknowl-

edgment that we need to find new energy sources to deal with the end of the century. So that would be my comment. Thank you.

Mr. EHLERS. Just a quick comment on that. Be real careful about relying too much on the industry. I have a great deal of respect for them, but this infrastructure system, the easiest thing for them to do is precisely what they are doing now, and that is planning to put reformers on the automobiles and continue to pump gasoline into the cars, because that is the easiest approach now. The infrastructure is there. I am saying we have to really rethink what the infrastructure should be if we are going to reduce the dependence.

Mr. CARD. And I just want to acknowledge the Secretary just had a meeting of major oil executives in Houston and gave a speech to them on that very subject, and I think the industry understands that our desire is to have—to put hydrogen in vehicles and not something else.

Mr. EHLERS. Yeah. Thank you. Dr. Marburger.

Dr. MARBURGER. Yes, and I would like to just add a word about the very big picture of funding for basic science. This committee has been very supportive of it. I just want to point out that basic science, it covers a very wide spectrum of activities. And there is a dynamic that is occurring in science right now that draws attention to certain areas and makes them very high priority for national investments. And this Administration will continue to attempt to discover priority areas and address the needs in those areas. There is nervousness about arbitrary formulas. I have—I said it last year, and I will say it again this year that it is really important to—in a time when there are lots of demands on public resources to be very conscious about what our criteria are, what our priorities are, and take care of the highest priority areas and fill in as we can the ones that are lower priority. I think that is what this budget is all about. And I look forward to working to continue to identify priority programs and funding them adequately.

Mr. EHLERS. And I appreciate your comments and your work. Let me simply—just to give an example for the military, in the 1930's, work was done in stimulated emissions radiation, which in the '50's, resulted in the laser. The atomic clock was developed based on research in the '40's, and that was developed in the '50's. Both of those enable our precision bombing today whether using GPS, that is based on the atomic clock, or using laser-guided weapons based on the laser, obviously. No one in the 1930's, '40's, '50's, even the '60's and '70's, ever thought that either of those would result in a huge military advantage for our country. And that is why it is so difficult to set priorities. And the essence of basic research is that if you knew what you were going to find, it is not basic. Basic research is really exploring the future that you can't see and recognizing it is going to have implications.

Thank you all very, very much for being here. You have been an excellent panel, very sage advice for us. I appreciate your presentations. The meeting is adjourned.

[Whereupon, at 12:24 p.m., the Committee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by John H. Marburger, III, Science Advisor to the President; Director, Office of Science and Technology Policy

Questions submitted by Chairman Boehlert

Q1. The Administration has identified increased funding for the National Science Foundation (NSF), and the physical sciences in particular, as being significant budget priorities. With the completion of final appropriations for fiscal year 2003, the increases requested for federal science and technology programs are much smaller than was indicated in your testimony before the Science Committee on February 13. For example, the 9 percent increase touted for the National Science Foundation is only slightly more than a three percent increase relative to the fiscal year 2003 appropriation.

Does the Administration believe that NSF should receive a significant increase above last year's appropriated amount? Will the Administration submit an amended budget request for R&D programs?

A1. The Administration will not change the 2004 budget based on the program or agency levels included in the 2003 Omnibus bill. The President's 2004 Budget was developed within a framework that set a proposed total for discretionary spending in 2004, and each agency and program request reflected the Administration's relative priority for that operation within that total. While we recognize that Congress may believe there is a need to reorder and adjust some of these priorities, the Administration intends to work with Congress to stay within the 2004 top-line amount, with the possible exception of addressing threats to the Nation's security. With regard to NSF specifically, the President's 2004 budget continues to provide a strong investment in excess of previously appropriated levels, reflecting this Administration's commitment to funding research.

Q2. The events of September 11, and subsequent computer viruses and worms have highlighted the vulnerability of our nation's critical infrastructure to attacks upon our computer networks. Congress responded by enacting P.L. 107–305, the Cyber Security Research and Development Act. This legislation authorized new computer security research programs at the National Science Foundation and the National Institute of Standards and Technology.

Investments are also being made at other agencies that participate in the interagency national information technology research and development program (NITRD).

Last year, the Committee asked the Office of Management and Budget how much money the Federal Government invested in cyber security research and development (excluding cryptography). The question could not be answered because cyber security research and development was not considered an important enough activity to be accounted for separately from other information technology research and development investments. How much money does the Administration intend to spend on cyber security research and development as part of its fiscal year 2004 budget, and at which agencies? How will this investment be coordinated?

A2. Investments in cyber security and cyber security R&D are extremely important to the Administration. Information on the following is currently collected and reported:

- information technology (IT) security (from IT project information collected from each agency),
- networking and IT R&D (a coordinated interagency R&D effort), and
- critical infrastructure protection R&D (part of the combating terrorism data).

Finding the intersection between these collections and identifying activities relevant to cyber security R&D that fall outside each of these efforts is key to getting a clear picture of the total federal cyber security R&D investment, but has proven challenging. OSTP and OMB are currently working to address these issues and develop a definition of cyber security R&D that agencies can use to identify and report on their planned FY 2005 activities. Agencies will be asked to quantify cyber security R&D funding within their FY 2005 request.

It is also important to note that federal funding represents only part of the picture; the private sector also makes significant R&D investments that contribute to cyber security capabilities. By continually reassessing the combined investments of

all sectors, we can take advantage of all developments and applications and better understand where future investments should be made. Funding levels can provide some perspective, but it is the particular activities funded and the effective coordination and application of their outcomes that promises to advance the security of our IT systems.

As you know, coordination of Networking and Information Technology R&D (NITRD) investments are handled through the National Science and Technology Council (NSTC), and these include most of the efforts relevant to cyber security. The NSTC structure is in the process of being updated to include a Subcommittee on Infrastructure, under which there will be a focus area on R&D related to the protection of critical information infrastructure. Agency representatives common to both groups will provide an additional level of coordination.

Q3. In Under Secretary Card's written testimony submitted to the Science Committee for its February 13 budget hearing, he indicated that the Department of Energy's (DOE) portion of the Climate Change Technology Program (CCTP) comprised $1.6 billion in research and development (R&D) programs. During the hearing, Mr. Card added that 90 percent of the CCTP resides in the Department of Energy. Can you provide details on the remaining $200 million in climate technology R&D that resides in other agencies?

A3. The FY 2003 budget request included $ 1.625 billion in climate change technology R&D funding, including $1.511 billion at DOE. Relevant research and development at DOE is in the areas of renewable energy ($408M), energy conservation ($588M), carbon sequestration ($54M), basic science ($35M), energy information ($3M), clean fossil energy ($398M), and the Nuclear Energy Research Initiative ($25M). In addition, about $108 million was proposed for R&D at EPA, and $6 million at USDA. More specific program details can be found in the Federal Climate Change Expenditures Report to Congress, July 2002.

Q4. The President's fiscal year 2004 budget request includes $7 million for a new Next Generation Computing Architecture program at the Department of Energy (DOE). My understanding is that this program will explore the question of whether DOE should embark on a program to develop vector architecture-based high performance computers, a development path quite different than that pursued by other agencies, including the National Science Foundation and the National Oceanic and Atmospheric Administration. How does DOE's new program fit in with advanced computation development activities at other agencies and how are these efforts coordinated across the Federal Government?

A4. The Next Generation Architecture program at DOE is a $14 million program that will explore technical issues related to high-end computing system architectures. The results of this program are expected to aid in the design of new generations of systems at DOE as well as at other federal departments and agencies with high end computing related activities. The program itself is not directly intended to address the question of whether or not DOE will undertake a particular high performance computing program in the future.

Among federal agencies, DOE has the second-largest investment in high-end computing R&D (after NSF). Traditionally, interagency R&D in high-end computing has been coordinated through the High End Computing Coordinating Group of the National Science and Technology Council's (NSTC's) Networking and Information Technology Research and Development (NITRD) Interagency Working Group. This group includes representatives from DOE and ten other federal agencies involved in high-end computing R&D, and meets on approximately a monthly basis to engage in interagency planning and coordination activities.

A separate interagency group, the High-End Computing Revitalization Task Force, has been established, also under the NSTC, for the purpose of conducting planning activities that will help guide future R&D investments in this area.

Q5. The President's budget fiscal year 2004 budget request indicates that a total of $3.2 billion is proposed for research and development (R&D) to combat terrorism. Of this, over $900 million is requested for R&D at the Department of Homeland Security (DHS), and $1.6 billion for biodefense R&D at the National Institutes of Health. What agencies and what programs account for the remaining $700 million of counterterrorism R&D? How will the DHS programs be coordinated with the relevant work at other federal agencies? In particular, since a large fraction of the DHS R&D is development and applied research, how will DHS take advantage of results from the basic research being done at other agencies? How will the Office of Science and Technology Policy and the Office of Homeland Defense coordinate these activities?

A5.

Estimated Funding for Combating Terrorism R&D:

Agency	Budget Authority
Health and Human Services	$ 1.8 B
Department of Homeland Security[1]	$ 0.9 B
National Science Foundation	$ 0.3 B
Department of Defense	$ 0.2 B
TOTAL:	**$ 3.2 B**

[1] Includes funding for S&T Directorate and components of Coast Guard, TSA, etc.

This $3.2 billion also includes smaller R&D efforts at other agencies, including the Environmental Protection Agency, Department of Commerce, and Department of Justice.

Coordination:

Several mechanisms exist for coordinating Homeland Security R&D across agencies. These include:

- Coordination of homeland security R&D across the federal agencies and departments is being done through the National Science and Technology Council (NSTC). The President chairs the NSTC, and membership consists of the Vice President, the President's Science Advisor and Director of OSTP, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials. OSTP manages the committees of the NSTC. Homeland Security working groups being formed under the NSTC Committee on Homeland and National Security include Radiological and Nuclear Countermeasures; Biological Countermeasures; Social, Behavioral, and Education; Standards; International Issues (to include biometrics); and Infrastructure.
- In addition, the Homeland Security Council (HSC), which is the successor to the Office of Homeland Security, is organizing several Policy Coordinating Committees to serve as the senior policy and subject matter expert forum for consideration of policy issues affecting homeland security. The Office of Science and Technology Policy (OSTP) is working with the HSC to provide technical expertise as needed.
- A Memorandum of Agreement (MOA) between the Department of Homeland Security and the Department of Health and Human Services commits to bilateral and multi-lateral coordination on research and development. Provisions in this MOA include joint development of an R&D strategic plan, participation in interagency R&D working groups, and routine exchange of senior scientific staff and management/program personnel.

Questions submitted by Representative Ralph M. Hall, Ranking Member of the Science Committee

Q1. The President's FY 2004 NASA budget request projects an almost five percent cut in funding for aeronautics technology through FY 2008. Given that the budget numbers now include personnel and benefits costs in the totals, the projected decline in funding actually allocated to aeronautics R&D projects is probably even steeper. This policy decision to decrease funding for aeronautics flies in the face of the Aerospace Commission's finding that the Nation needs to invest more *in aeronautics technology. Can you explain why the Administration has decided to do this?*

A1. NASA's aeronautics research investments should not be judged solely on year-to-year funding trends for NASA's overall aeronautics budget. NASA's aeronautics budget supports a large number of research programs and projects in varying stages of development. The trend in the overall aeronautics budget can mask actual program increases and previously planned decreases within this total. As described

below, the FY 2004 request for NASA funds a number of important program initiatives and increases that are consistent with priorities identified in the Aerospace Commission report. More importantly, as NASA Administrator Sean O'Keefe has pointed out in prior testimony, the most important measure of NASA's aeronautics research investments is not the dollar amount going into these programs but the utility of the research products coming out of them.

The FY 2004 budget request for NASA's Aeronautics Technology programs is $959 million, a one percent increase (+$12 million) from the 2003 budget request. Within this total, a number of key programs are supported consistent with the priorities identified in the Aerospace Commission report, including investments in technologies to: improve aviation safety and security ($169 million), modernize the air transportation system ($217 million), and develop the breakthrough technologies necessary to enable the next generation of air vehicle systems ($574 million). Within these amounts, there are a number of important initiatives and increases, which are also consistent with priorities identified in the Aerospace Commission report. These include:

- $27 million to enable the transition of technologies into the future National Airspace System;
- a $15 million increase for the Quiet Aircraft Technology program to develop technologies that can help reduce jet engine and aircraft noise; and
- $21 million to develop technologies that can help protect aircraft and the airspace system from criminal and terrorist attacks while dramatically improving the efficiency of security.

NASA investments in these technology areas represent a balanced approach to long-term, high-risk, high-payoff research and in both nearer-term and longer-term research focused on public good issues.

It should also be noted that the overall budget decreases shown for FY 2005 through FY 2008 can be primarily attributed to the Airspace Systems program, within which two major projects are planned for completion. The Advanced Air Transportation Technologies (AATT) project will be completed in FY 2004 and the Virtual Airspace Modeling & Simulation (VAMS) project will be completed in FY 2007.

Q2. In your testimony, you point out that the budget request provides $100 million for FAA "to maintain its focus" on safety and environmental (noise & emissions) research. This proposal cuts the budget for these activities by 21 percent from the FY 2003 request and 34 percent below the FY 2002 appropriations level. Explain the rationale and justification for cuts of this magnitude for research activities that are central to the future safety and competitiveness of the U.S. air transportation sector.

A2. The $100 million budget for FAA research, engineering, and development maintains its strong commitment to safety at this agency. While it is true that budget reductions totaled 21 percent from the FY 2003 request, it is not true that research activities related to enhancing safety and the environment have been compromised.

The Administration recognizes that research efforts are critical to the reduction of aviation accident rates. In fact, the Aviation System Safety program has been increased by four percent from $42.3 million to $44.0 million. The Environment and Energy program request was also increased, from $7.55 million to $7.975 million. Another clear example of the FAA focus on safety is illustrated by the $1.5 million increase (to $20.9 million) in weather research safety.

Q3. In your testimony you mention that the National Science and Technology Council will be reviewing management aspects of research funding including an investigation of the changing business model for research. What exactly are the characteristics of the "changing research environment" that you cite as being in need of "modernization"?

A3. OSTP and others are keenly aware that much has changed about the practice of scientific research over time. Researchers in an increasing number of fields are requiring ever more complex and expensive tools to carry out their work. Furthermore, many of the most compelling questions facing science today can only be tackled by larger groups of researchers working across traditional disciplinary boundaries. The purpose of the Subcommittee on Research Business Models is to advise and assist OSTP and the NSTC on policies, procedures and plans relating to business models for the performance and management of federally sponsored scientific research. The Subcommittee will facilitate a strong, coordinated effort across federal agencies to identify and address important policy implications arising from the

changing nature of scientific research noted previously. The Subcommittee will also examine the concomitant influence these changes have had *or should have* on business models and business practices for the conduct of scientific research sponsored by the Federal Government and carried out by academic, industrial, and government entities.

The NSTC Subcommittee on Research Business Models is co-chaired by Dr. Constance Atwell of the National Institutes of Health and Dr. Rodney Brown of the U.S. Department of Agriculture. Initially, the subcommittee will focus on policy issues related to three broad areas: (1) defining common language and streamlining procedures and regulations among the research funding agencies, (2) alignment of funding mechanisms with scientific opportunities, and (3) investigating how the changing nature of scientific research in academia and government laboratories affect the cost of research.

Q4. You point out in your testimony that in 2004 all federal R&D managers must demonstrate the extent to which their programs meet the tests of relevance, quality, and performance. What guidelines and metrics are available to assist R&D managers in matching programs against these broad criteria? For basic research programs, for example, what would be reasonable metrics for assessing performance?

A4. Metrics for measuring R&D program performance form only one part of the overall effort begun under the President's Management Agenda to improve the effectiveness of the Federal Government's research and development investments. The framework provided by the R&D investment criteria seek to bring information about three fundamental aspects of R&D—relevance, quality, and performance—into the process for making budget decisions. The criteria outlined in last year's joint OSTP–OMB guidance for interagency R&D provided guidelines in the broad sense, but specific guidelines and especially metrics must be determined in the context of each type of research program.

For most research programs, this was the first year of implementation of the investment criteria. A number of agencies are recasting their strategic plans to tie more directly to the R&D criteria, and others are revising their research performance goals to be both clearer and more ambitious.

OSTP remains involved in the effort to improve the management and effectiveness of the Federal Government's research and development programs. OSTP has established an interagency working group to discuss implementation of the investment criteria. As part of that effort, OSTP commissioned the RAND Science & Technology Policy Institute to undertake a project this year that will assist agencies and OMB by seeking out and documenting short case studies of the "best practices" or mechanisms used to evaluate relevance, quality, and performance of federal R&D programs. The results are intended to enable agencies to learn from one another with the ultimate goal of improved R&D program management and effectiveness.

Direct assessment of performance of basic research programs is notoriously difficult, due to the long time horizons for research payoffs and the uncertainty of results from cutting edge research. Therefore, in approaching the assessment of basic research programs we took an approach of leaning heavily on the judgments of independent review boards as they assess the way the research programs are structured, managed and overseen. This allows a fresh view of the program by technical experts at an arm's length from the program.

OSTP guided the development of a small number of sensible performance metrics for the basic research programs in the General Science & Technology function (Function 250). These metrics, though not all inclusive, indicate that large construction projects should not exceed more than 10 percent of cost or schedule baselines, that scientific facilities should deliver at least 90 percent of scheduled operating hours, and that at least 80 percent of research funds should be awarded using a competitive, peer-reviewed mechanism.

Q5. Please explain OMB's Program Assessment Rating Tool (PART), which was developed for evaluation of federal science agencies' programs. Did OSTP contribute to the development of PART?

A5. The Program Assessment Rating Tool (PART) is a questionnaire designed to provide a consistent approach to rating programs across the Federal Government. The PART is a diagnostic tool that helps develop evidence-based assessments and evaluations of programs across a wide range of issues related to performance including program purpose and design, strategic planning, management and results and accountability. The questions are designed to reflect familiar concepts and incorporate existing practices managers and program examiners utilize to assess program performance. The formalization of performance evaluation through this proc-

ess is intended to develop defensible and consistent ratings of programs for the FY 2004 budget and beyond.

The questions are written in a Yes/No format (except for one section, in which there are four options for responses) and require users to provide a brief narrative explanation of the answer including any relevant evidence to substantiate the answer. Responses should be evidence-based and the worksheet requires that the explanation and evidence of the answer be provided. The completed PART worksheets and summaries are available to the public on the OMB website *(http://www.whitehouse.gov/omb/budget/fy2004/pma.html).* Unless otherwise noted, a *Yes* answer should be definite and reflect a very high standard of performance. Hard evidence of performance may not be readily available for all programs. In these cases, assessments will rely more heavily on professional judgment. No one question in isolation will determine the performance of a program. In fact, reviewers have the option of skipping,questions that are not relevant to a particular program.

PARTs were tailored to seven types of federal programs. Research and development was one of those seven program types. While OSTP was not involved with the development of questions that were common to all seven PARTS, OMB based the R&D PART in large measure on the R&D Investment Criteria that OSTP worked with OMB to develop. OSTP has been asked for comments for the 2005 revisions to the PART, along with all federal agencies and the public.

Q6. What is the relationship between PART and GPRA?

A6. The PART builds on the GPRA framework. The PART incorporates information about program design and purpose along with program and financial management into the GPRA framework of strategic plans, performance plans, and performance reports.

The PART requires OMB and agencies to choose performance measures that meaningfully reflect the mission of the program, not merely ones for which there are data. The measures are intended to reflect a sense of program priorities and therefore will likely be few in number. As a general approach, measures should reflect desired program outcomes and be limited in number; however, there may be instances where a more narrow approach is more appropriate and output measures are acceptable. The discussions on performance measures are one of the most valuable aspects of the PART process.

The existing Government Performance and Results Act (GPRA) performance measures served as starting point, although in many cases they needed to be revised significantly or new measures needed to be developed to meet PART standards, in particular its focus on outcomes. New measures developed while completing the PART should be included in agency strategic and performance plans.

Q7. What role does the PART evaluation have in determining agencies' funding levels? Please provide examples from the FY04 budget submission of the way in which PART or other metrics developed for evaluation of R&D programs have shaped funding requests or program directions.

A7. Funding decisions in the FY 2004 budget request were shaped with the assistance of both the PART and the R&D investment criteria, especially for applied energy research programs and projects at the Department of Energy. The results of these evaluations resulted in shifting funding from activities supporting technologies that are near commercialization, such as clean coal demonstration projects, to long-term, high-risk R&D, such as research on new ways to store large amounts of hydrogen in small spaces. This hydrogen research will help advance the introduction of fuel cell vehicles. In another case, the investment criteria were used to determine that the Advanced Petroleum-Based Fuel program supplants private investments that would otherwise be made to achieve the clean air requirements of EPA's regulations. The FY 2004 budget proposes significantly reduced funding for this program.

Q8. Sixteen Democratic Members of the Science Committee sent a letter to President Bush on February 6th expressing concern over the perceived lack of independence of the Space Shuttle Columbia Accident Investigation Board and asking him to take steps to rectify the situation. At the February 12th joint hearing on the accident, a number of Republican members indicated that they share these concerns.

a. Has the President asked your opinion on this issue?

b. What, if anything, would you recommend that the President do in response to the bipartisan concerns over the Accident Investigation Board charter and membership?

A8. Immediately following the February 1 *Columbia* accident, NASA Administrator Sean O'Keefe established the Columbia Accident Investigation Board (CAIB) to provide an independent panel of experts to investigate the cause of the accident. The CAIB was established in accordance with the contingency action plan that NASA had updated prior to the *Columbia* launch, as it does prior to each launch of the Space Shuttle or International Space Station expedition crew. Retired U.S. Navy Admiral Harold Gehman was appointed as chair of the CAIB.

Since the establishment of the Gehman Board, Administrator O'Keefe has modified the charter of the CAIB on three occasions—February 6, February 12, and February 18—without prompting by the White House. These modifications to the charter have been made to ensure the independence of the Board, the presence of the right expertise on the Board, and freedom of the Board to draw upon whatever resources may be necessary from within and outside of NASA to complete the investigation.

With regard to my communications with the President, on the day of the *Columbia* accident, I briefed the President, along with Dr. Condoleeza Rice and Secretary Tom Ridge, about the accident, the initial stages of the debris recovery efforts, and the initiation of NASA's contingency action plan. Since then, I have spoken to him on a number of occasions about the *Columbia* investigation. I have complete confidence in Admiral Gehman, his staff, and his independence in conducting this investigation and believe that any further changes to the CAIB, its charter, or its membership should be determined by Admiral Gehman, and I have communicated this to the President.

Q9. What changes will you make to the Administration's plans for the Nation's space program in response to the loss of the Space Shuttle Columbia? If you don't yet know, have you set up a process to make that determination? If so, what is the process and when will it be complete?

A9. It is too early to assess what the impact of the *Columbia* accident will be on our nation's activities in space. We will await the findings and recommendations of the Columbia Accident Investigation Board (CAIB) before making any decisions regarding changes to the Space Shuttle, International Space Station, and other space programs. At this time, no formal process has been established to review CAIB's recommendations.

Q10. There have been press reports that the U.S. government is in discussions with Russia regarding Russian support for the Space Station while the Shuttle fleet is grounded. Is that true? If so, what is being proposed?

A10. NASA has been engaged in discussions with its international partners, including Russia, regarding how best to maintain and support the International Space Station (ISS) until the Space Shuttle fleet is able to return to flight. At a February 27 Multilateral Control Board (MCB) meeting, the international partners reached consensus on reducing the ISS expedition crew from three to two, consisting of one Russian and one American. U.S. astronauts Edward Lu and Michael Foale are currently in Russia training as a prime and backup at the cosmonaut training facility, Star City, along with cosmonauts Yuri Malenchenko and Alexander Kaleri. Consensus was also reached on adding one Progress flight in each of 2003 and 2004. NASA is in discussion with its international partners regarding seeking a partnership solution with respect to any additional resources that may be required to maintain the Station in orbit while the Space Shuttle fleet is grounded.

Q11. The Administration has been criticized for having applied ideological litmus tests and for not having written conflict-of-interest policies for nominees to scientific advisory panels. What role does OSTP play in establishing rules and guidelines for the selection of individuals to serve on scientific advisory panels for federal agencies? What criteria should be applied to the selection of such individuals in addition to their scientific and technical credentials?

A11. OSTP does not play a role in establishing rules and guidelines that federal agencies use in the selection of members of scientific advisory panels. We believe that individuals' scientific and technical credentials must be of the highest calibur in order to carry out the critical assignment of ensuring that public funds are invested wisely in areas and projects that meet the most stringent test of merit.

Q12. Some universities have reported problems with foreign graduate students being able to obtain visas to enter the U.S. This has occurred with new students and with enrolled students attempting to return to the U.S. after brief visits home. Are you aware of these problems, and does your office have any interactions

with the Department of State to help ensure the visa approval process is not unnecessarily impeding university-based research?

A12. Yes, I am well aware of the problems, and OSTP has been and continues to work with State, FBI, CIA and other relevant agencies to address the problems of the visa delays for students, scientists and researchers. OSTP is working actively to eliminate two sets of backlogs, one on Condor cables and one on Mantis cables. Condor cables are generic reviews and background checks to screen for an applicant's ties to terrorism. The backlog on Condor cables grew over the summer of 2002 and impacted students trying to enter the U.S. to begin the Fall semester. On September 4, 2002, OSTP and the Office of Homeland Security (now the Homeland Security Council (HSC)) met with the relevant agencies to surface inefficiencies and improve the screening process. As a result, a backlog of over 10,000 visa applications was reduced, and the Condor reviews are on track to be completed within 30 days unless the visa applicant requires additional screening.

Mantis cables are substantive reviews and background checks to screen S&T-related applicants for potential violations of nonproliferation and export control laws based on a "Technology Alert List." The State Department vastly expanded its Technology Alert List last August, 2002, and included a number of course work categories that are provided by universities, such as chemical engineering, biochemistry, microbiology, architecture, housing, urban design and others. The State Department reports that their action raised the volume of Mantis cables from 2,000 in CY 2001 to over 14,000 Mantis cables in CY 2002. The Mantis program has been the primary bottleneck impacting visa delays for scientific conferences, students returning from the December holiday, H1Bs returning from trips overseas, government-scientist meetings and other science and technical research-related visa problems. Although the nonproliferation department at State coordinates the technical reviews, FBI and CIA checks are also required on these visa applications. On January 29, 2003, OSTP and HSC met with the relevant agencies to surface problems in the Mantis visa screening process and to encourage State and FBI to improve the timeliness and efficiency of visa processing. OSTP and HSC are having ongoing meetings with State and FBI to work on these issues, and we have specifically asked them to review the entire backlog of cases and ensure that all applications are being handled as efficiently as possible. As a matter of policy, OSTP does not intervene in individual visa cases.

Q13. Overall, what has been the effect on the ability of U.S. universities to obtain foreign graduate students of efforts to more closely monitor foreign students for homeland security needs? What is the current status of the implementation of SEVIS for tracking foreign students?

A13. The effect on universities to obtain international students is not entirely clear. A survey by the American Association of Universities and the NAFSA Association of International Educators, published on November 14, 2002 showed that the number of enrollments of international students at U.S. universities had increased and that the number of scholars on J-visas had declined. Students from some countries (i.e., China) were impacted more than others. What is unknown is the extent to which increases in university enrollments in Australia, the United Kingdom, or a student's home country is attributed to the (actual or perceived) fear of new security measures.

The current status of the SEVIS tracking system is that as of March 1, responsibility for SEVIS has transitioned to the Department of Homeland Security, Border and Transportation Security Directorate. At the time of transition, 4,121 schools and 1,200 J-programs had been cleared to use SEVIS (almost 100 percent of J-programs). In Regulation 67FR–76256, published 12.11.2002, INS promised to finish adjudicating all schools by January 30, *if they completed the application process by November 15.* New SEVIS school applications continue to roll in at the pace of 20–50 per day. These are adjudicated on a rolling basis. There are also some schools whose applications were incomplete, who bounced checks, or have not yet responded to INS requests for additional information. The total number of applications submitted in various stages and which are continuing to be processed as of today is 1,600. The next major challenge for the SEVIS program will be completing the batch upload process for schools reporting existing international students through SEVIS. All international students (F, M and J visa holders) are to be registered through SEVIS by August 1, 2003.

Q14. Please describe how the agencies' requests for observing systems and science data management are coordinated. What is OSTP's role in coordination?

A14. Some observing systems (climate, oceans, earth, etc.) and related data management activities are coordinated through a variety of interagency mechanisms. For example, the Climate Observing System is being developed and coordinated by the 13-agency Committee on Climate Change Science and Technology Integration. The Ocean Observing System is being handled the congressionally mandated National Ocean Research Leadership Council. Efforts to establish a broader Earth Observing System are being led by the National Science and Technology Council. OSTP plays a major role in each of these activities—providing policy guidance and budgetary review in collaboration with the Office of Management and Budget. Other observing systems (e.g., observations that occur at NSF LTER sites and observations related to seismic and volcanic activity) require less interagency coordination or OSTP involvement.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Samuel W. Bodman, Deputy Secretary, U.S. Department of Commerce

Questions submitted by Chairman Sherwood Boehlert

Q1. The combined National Oceanic and Atmospheric Administration and Department of Defense budget request for the National Polar-Orbiting Environmental Satellite System (NPOESS) for fiscal year 2004 is $560 million, which is about $50 million less than the program's budget planning document states is required this year. What alterations to the program are expected given the reduced funding request? Will the decrease in expected funding change the number or specifications for the sensors? Please provide a specific list of the sensors that are currently planned and what function each will perform. Will the first satellite be ready for launch in 2009, which is already a postponement from the original plan?

A1. The FY 2003 President's Budget Request of $474.5 million ($237.3 million for the Department of Commerce/NOAA (DOC/NOAA) and $237.2 for the Department of Defense (DOD)) supported the following NPOESS-related launch dates:

- CY 2005 launch of the NPOESS Preparatory Project (NPP), a risk-reduction mission for NPOESS; and
- CY 2009 for the launch of the first NPOESS satellite, C–1.

The FY 2004 President's Budget Request is $544.7 million, of which DOC/NOAA's portion is $276.7 million, and DOD's portion is $268.0 million. This FY 2004 request supports:

- CY 2006 launch of NPP; and
- CY 2009 launch of the first NPOESS satellite, followed by launch of the second NPOESS satellite in CY 2011.

The FY 2004 President's Budget Request was submitted before receipt of the FY 2003 enacted amounts. Therefore, FY 2004 program planning was based on the FY 2003 budget request, revised funding profiles after the award of the NPOESS prime contractor, and a thorough review of the satellite systems and user requirements. The FY 2003 Omnibus Appropriation for the NPOESS program was less than was requested by the President. The overall loss in funding was $28.893 million to the combined program, of which NOAA's reduction was $23 million. The NPOESS Integrated Program Office is currently reviewing the impacts on the overall program schedule.

At this time, we do not anticipate any decreases in satellite capability, neither in number nor performance of sensors. The only addition in the proposed sensor package was the addition of the aerosol polarimeter, which was determined to be necessary after the submission of the FY 2003 President's Budget.

Planned Sensors:

Visible/Infrared Imaging Radiometer Suite (VIIRS):

Three orbits, high precision, near constant resolution, multi-spectral imagery (22 "colors").

- Imagery* [1]
- Sea*, ice and land surface temperature
- Aerosol particle size and optical thickness
- Surface albedo
- Cloud cover, layers, particle size, optical thickness, height, and pressure/temperature of tops
- Ocean color/chlorophyll
- Precipitable water and suspended matter
- Sea ice characterization
- Surface type and vegetative index

Conically-scanning Microwave Imager and Sounder (CMIS):

Three orbits, imagery through clouds and sounding.

[1] * Note: Environmental data types with Key Attributes which would require replacement of a satellite if a sensor becomes unable to perform.

- Sea surface winds*
- Soil moisture*
- Cloud base height and ice/liquid water
- Atmospheric pressure, moisture and temperature vertical profiles (low resolution)
- Sea, ice and land surface temperature through clouds
- Precipitation type and rate
- Snow cover and depth
- Atmospheric total water content
- Surface type and sea ice characterization

Cross-track Infrared and Microwave Sounding Suite (CrIMSS):

Pair of sounding instruments on two orbits (comprised of the Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS)).

- Atmospheric pressure, moisture* and temperature* vertical profiles (high resolution)

Ozone Mapping Profiler Suite (OMPS):

Single orbit of ultraviolet down-looking and horizon-viewing instruments.

- Ozone total column map and vertical profile (Treaty Requirement)

Space Environmental Sensing Suite (SESS):

Collection of instruments to measure ionospheric and electromagnetic space conditions.

- Auroral boundary, energy deposition and imagery
- Electric and geomagnetic fields
- Electron density and neutral density profiles
- Energetic ions and medium energy charged particles
- Supra-thermal-auroral particles
- *In-situ* plasma temperature and fluctuations
- Ionospheric scintillation *(in-situ)*

Global Positioning System Occultation Sensor (GPSOS):

Ionospheric sounding instruments on one orbit.

- Electron density profile
- Ionospheric scintillation (horizon)

Earth Radiation Budget Sensor (ERBS):

Single orbit to record balance of reflected and emitted energy. Used to help model the Earth's energy balance to understand climate.

- Downward radiance, long- and short-wave
- Net heat flux
- Net solar radiation, top of atmosphere
- Outgoing long-wave radiation, top of atmosphere

Total Solar Irradiance Sensor (TSIS):

Continuously measures energy from the sun from a single orbit. Used to help model the sun's energy input to the Earth. With the EBBS, helps understand Earth's energy balance to understand climate.

- Solar irradiance

Altimeter (ALT):

Single highly precise radar altimeter.

- Ocean wave characteristics
- Sea surface height/topography (used to see if the ocean is rising)
- Wind stress

Aerosol Polarimetry Sensor (APS):

Single sensor. Measures the distribution and shape of small particles suspended in the air. This gives indications as to source—natural or man-made.

- Aerosol optical thickness, particle size and refractive index

• Cloud particle size and distribution

In addition, some satellites carry the following instruments:

Search and Rescue Satellite Aided Tracking (SARSAT) (all satellites)

ARGOS Data Collection System (ADCS) (two orbits)

Survivability Sensor (SS) attack warning sensor (all satellites)

Three orbital planes are polar sun-synchronous orbits with local ascending node times (equatorial crossing from south to north) of 1330, 1730 and 2130 hours.

Instruments in 1330 orbital plane:

•VIIRS	•CMIS	•CrIS/ATMS	•OMPS	•SESS
•GPSOS	•ERBS	•SARSAT	•ADCS	•SS

Instruments in 1730 orbital plane:

•VIIRS	•CMIS	•CrIS/ATMS	•ALT
•TSIS	•SARSAT	•ADCS	•SS

Instruments in 2130 orbital plane:

•VIIRS	•CMIS	•APS	•SARSAT	•SS

All satellites can accommodate all instruments. The configuration launched is determined at the time of call-up depending on the operational needs of the environmental satellite data using community.

Q2. The events of September 11, and subsequent computer viruses and worms have highlighted the vulnerability of our nation's critical infrastructure to attacks upon our computer networks. Congress responded by enacting P.L. 107–305, the Cyber Security Research and Development Act. This legislation authorized new computer security research programs at the National Institute of Standards and Technology (NIST). What portion of the fiscal year 2004 budget request for NIST will be devoted to implementing this Act and what is your schedule for implementation?

A2. P.L. 107–305 authorizes new funding for computer and network security in order to bolster the Nation's ability to respond to threats from cyber attacks and against the computer and communications networks on which our finance, transportation, health and emergency services systems depend. The Department understands the need for the Nation to secure its information systems and the Administration supported enactment of the Cyber Security Act.

Although the FY 2004 budget request does not specifically fund all of the activities authorized by the Cyber Security Research and Development Act, the request does make a significant $25 million investment in critical infrastructure protection—cyber security research and development. With this funding, NIST will continue to improve cyber security and critical infrastructure security by raising awareness of the need for cost-effective security, engaging in voluntary standards activities, developing standards and guidelines, and providing national leadership for security evaluation and testing.

Through its work in information security standards, testing and research, NIST will also continue to help strengthen the security of commercial IT products, which provide the communications and information processing backbone of our nation's infrastructures. NIST's efforts enhance the security of products and support users' confidence in their systems and networks, thus enabling more widespread and secure infrastructures supporting homeland security, e-government and e-commerce. In addition, funding is requested for the development and implementation of improved standards, technology and practices for fire safety and security, retrofit and design of structures. Funding is also requested to provide standard methods for measurements of biometric identification systems in compliance with the USA PATRIOT ACT.

Questions submitted by Ralph M. Hall, Ranking Member of the Science Committee

Q1. Your written testimony mentioned how resources have been shifted from various lower priority programs and that the Department's resources are directed to the areas having the greatest impact and best coordination to meet national needs. What are the criteria and decision-making processes used by the department in determining the priority of a program? Could you also provide details of how you assess a program's impact and coordination to meet national If needs?

A1. In determining the Department's priorities for FY 2004, Secretary Evans and I have consulted closely with leaders of other federal science and technology agencies to ensure that the Department's resources are directed toward areas where we can have the greatest impact on national needs. We have also met with constituents of individual programs from the research community and private industry and received first-hand accounts of program successes and impact. The Department's entire budget request of $5.4 billion supports the key priorities that Secretary Evans and I developed with the Commerce leadership team and used to guide our budgetary decisions: fostering the Nation's economic growth; securing our homeland and enhancing public safety; upgrading the Department's facilities, infrastructure, and safety; improving and streamlining the Nation's fishery management system to better meet commercial, recreational, and conservation objectives; and implementing the Administration's Climate Change Research Initiative (CCRI) to reduce present uncertainties in climate science, and support policy and management decisions to benefit public safety and quality of life.

Key components of our budget request support these over-arching priorities. For example, NIST conducts world-class research on measurements, standards and technology that other agencies and the private sector depend on to enhance productivity, facilitate trade and improve the quality of life. Improvements to NIST's safety operations and laboratories at Boulder, Colorado, and Gaithersburg, Maryland, are long overdue. We believe that it is essential to focus resources on the Department's critical infrastructure needs so that NIST can continue to meet its important mission.

Climate change research is another top priority. The President has said repeatedly that we must harness the power of science and breakthrough technologies. We are working with our federal agency partners to build a focused science program to improve the information available to policy-makers. The President's CCRI led to the creation of a new interagency framework to enhance coordination of federal agency resources and research activities. Thirteen federal agencies are working together under the leadership of a Cabinet-level committee, headed by Secretary of Commerce Evans, Secretary of Energy Abraham, and Office of Science and Technology Policy (OSTP) Director Marburger, to improve the value of U.S. climate change research. Even in this time of difficult budget decisions, the President is committed to fully funding climate research.

Q2. In testimony before the Science Committee last year, you stated that TA had issued a number of reports and held numerous roundtables. How have the recommendations of these report and roundtables been implemented, particularly with a focus on the outcomes of TA work? For example, last year your testimony indicated that you had hosted the first in a series of roundtables bringing together federal officials and corporate R&D leaders to examine how the Federal Government can best help the private sector while deploying our own resources most strategically. In a subsequent hearing, Under Secretary Bond told us about TA leading a series of discussions in innovation in America at the start of the 21st century. The results of these roundtables were to result in TA proposing new initiatives and policies to maintain U.S. leadership. What are these new initiatives and polices and how are they being implemented by the Administration?

A2. The Technology Administration's Office of Technology Policy (OTP) has been very productive over the past two years. After producing an average of 3.5 reports annually from 1997 through 2001, OTP produced 11 reports in 2002 (with still more in research or production for 2003). Likewise, OTP outreach to the innovation community (industry, universities, labs) increased significantly, in daily meetings as well as more formal roundtables and conferences. Many of these efforts highlighted facts and trends important for policy-makers, while others offered more specific recommendations or suggestions. The Innovation in America series proved particularly enlightening and triggered interest from multiple companies, universities and nations.

Similarly, over the past two years, OTP has provided valuable recommendations and guidance to leaders and organizations across the Executive Branch. OTP's input and partnership are sought regularly across the Commerce Department (including

the Office of the Secretary), in policy shops throughout the White House (such as NEC, CEA, OSTP) and by outside organizations, such as the President's Council of Advisors on Science and Technology (PCAST). OTP leadership is routinely asked to participate in private sector discussions, conferences and events (more than 120 in 23 states last year), bringing the expertise and knowledge gleaned from their policy work and reports. The Innovation in America series informed and impacted OTP and Commerce Department policy recommendations on issues including federal R&D funding, workforce preparation and training, intellectual property protection, broadband usage, spectrum, tax and trade policies, liability and regulatory reforms, advanced education technologies, and e-government, among others.

As you know well, policy is usually the product of multiple inputs. While OTP routinely advises Commerce Department and White House leaders, it would be inaccurate to credit this one shop with specific policies, decisions or initiatives. Nevertheless, OTP's inputs have led to outcomes across multiple efforts by this Administration—indeed a majority of technology policy decisions and positions benefited from OTP's participation. To offer a few examples:

- OTP's hydrogen fuel cell research (resulting in the attached report) was instrumental in building the case for the hydrogen fuel cell initiative announced by the President in the State of the Union Address.
- OTP's support for the PCAST Technology Transfer Working Group drew heavily on information supplied by roundtable participants and appears likely to impact PCAST recommendations.
- OTP was and remains a leading participant in crafting and managing the Digital Freedom Initiative recently announced by the Secretary.
- The Economic Development Administration (EDA) has praised OTP's leadership on regional technology-led economic development as instructive to EDA's mission and efforts, while private sector associations report that its data helps economic development practitioners.
- Following on the comments of many roundtable participants regarding advanced information infrastructure, OTP has led Administration efforts on understanding and encouraging broadband demand, including broadband and business productivity and digital rights management.
- OSTP, NSF and PCAST have credited OTP's work, analysis and support on nanotechnology and the National Nanotechnology Initiative.
- OTP's Summit on the Use of Advanced Technologies in Education and Learning (in partnership with the Department of Education) led to creation of a report entitled, *2020 Visions: Transforming Education and Training Through Advanced Technologies.* This report is offered by over 50 web sites in over 10 foreign countries and appears likely to spawn an NSTC working group.

Q3. The Administration proposes to eliminate the Advanced Technology Program and the Manufacturing Extension Partnership, which were once considered important components of the Nation's technology policy efforts. Would you please outline the Administration's technology policy and programs that support this policy(s)?

A3. In June 2002, the President released his technology agenda entitled, "Promoting Innovation and Competitiveness." The report listed three technology priorities:

- *Promoting innovation,* by fostering the development and deployment of broadband, strengthening research and development funding, and implementing landmark education reform legislation, including significant improvements in math and science education;
- *Supporting entrepreneurship,* by removing competitive barriers overseas, reforming the U.S. high tech export control system, and reducing the tax burden on successful entrepreneurs; and
- *Empowering citizens,* by expanding the federal commitment to e-government, promoting assistive technology, and strengthening privacy protections.

The report is attached for the Committee's reference and can also be located at *http://www.whitehouse.gov/infocus/technology/tech_factsheet.pdf.*

Q4. The Administration has frequently justified eliminating funding for the Manufacturing Extension Partnership Centers by stating that the original intent of the legislation was to limit federal funding to Centers to six years. This was regardless of the fact that Congress had amended the statute to eliminate the six-year limitation. The legislation package for the Technology Administration and the

National Institute of Standards and Technology that the Administration sent to Congress on 30 September 2002 contained many amendments to NIST programs, including a "number of improvements to the Advanced Technology Program and the Manufacturing Extension Partnership Program." However, among all these improvements, the Administration did not include limiting funding to MEP Centers to six years. If this was an important factor in the Administration's decision to eliminate funding for MEP Centers after six years, why wasn't it included in your legislative proposals for the program?

A4. The President's Fiscal Year 2004 request for National Institute of Standards and Technology (NIST) programs included a prioritization of funding in a very difficult budget. The highest NIST funding priorities have been given to the world-class laboratory programs and infrastructure construction to provide for state-of-the-art facilities. Consequently, these funding limits did not allow for the MEP to fully fund all of its centers. Preference for the limited funding was given to those centers less than six years old.

The reason that the legislative package submitted by the Technology Administration and NIST did not include a legislative proposal "sunsetting" funding to centers is that such language is not necessary. The language contained in the statute (15 USC§278k(c)(5)) states, "After the sixth year, a Center may receive additional financial support under this section.. . ." This statutory language gives the Secretary discretionary authority to fund or not to fund the centers after the sixth year. The Administration has proposed to exercise its discretion, and not fund centers past their sixth year.

Q5. Last year the President signed into law the Cyber Security R&D Act (P.L. 107–355). This Act significantly increased funding for cyber security research programs to be implemented through NIST. Although much has been made about improving the security of the Nation's information infrastructure, the budget request does not include any funding for these research activities. Why does computer security seem to be such a low priority in the NIST budget request?

A5. The Administration understands the need for the Nation to secure its information systems and thus signed into law the Cyber Security R&D Act. In FY 2003, the President requested and received appropriations for two new NIST initiatives in support of computer and information security. The Computer Security Expert Assist Team and the Wireless Technologies, Computer Security Checklists and Guidelines will strengthen our cyber security programs. The FY 2004 Budget Request proposes an increase of $3 million to accelerate NIST's quantum information program. This program, which is led by two Nobel Laureates, has the potential to revolutionize cryptography and secure communications.

Although the FY 2004 Budget Request does not specifically fund the activities authorized by the Cyber Security Research and Development Act, the request does make a significant $25 million investment in critical infrastructure protection—cyber security research and development. With this funding, NIST is improving cyber security and critical infrastructure security by raising awareness of the need for cost-effective security, engaging in voluntary standards activities, developing standards and guidelines, and providing national leadership for security evaluation and testing. Through its work in information security standards, testing and research, NIST will also continue to help strengthen the security of commercial IT products, which provide the communications and information processing backbone of our nation's infrastructures. NIST's efforts to enhance the security of products support users' confidence in their systems and networks, thus enabling more widespread and secure infrastructures supporting homeland security, e-government and e-commerce. In addition, funding is requested for the development and implementation of improved standards, technology and practices for fire safety and security, retrofit and design of structures. Funding is also requested to provide standard methods for measurements of biometric identification systems in compliance with the USA PATRIOT ACT.

Q6. The computer security lab at NIST should play an important role in improving the security of federal computer systems, and the Administration has repeatedly stated the need to improve federal computer security. However, NIST has habitually been under-funded, and this year's budget request looks no different. What are the reasons for not strengthening NIST's capabilities? There are also reports that information technology security research at the Department of Homeland Security will receive a significant funding increase. Could you explain the interaction and synergy that will occur between DHS and NIST's computer security division?

A6. NIST envisions cooperation with DHS in the cyber security field both via their Science and Technology Directorate as well as with the Directorate for Information Analysis and Infrastructure Protection. We hope that we will be able to identify numerous areas of mutual collaboration as NIST will be able to bring to the table its long-standing competencies in many key areas, including: cyber security, SCADA (systems control and data acquisition) security, voluntary consensus standards/specifications development, and conformance testing. We believe all of these will be of great benefit to support the mission of DHS. We take our work in support of homeland security to include cyber security most seriously and, in fact, homeland security has been identified as one of our focus areas in NIST's strategic planning process.

NIST plays a unique role in the Nation's broader homeland security and national security strategy: NIST provides the measurements, standards, and tests to ensure that national security and homeland security technologies can be developed, manufactured, tested, implemented, and where appropriate, certified. NIST has served this role in national and homeland security for nearly 100 years. Agencies slated to join DHS have looked to NIST for decades for such measurement and standards support to fulfill their missions.

For example, NIST already works very closely with DHS through the Science and Technology Directorate to help DHS develop their homeland security standards strategy and to provide specific technical measurements and standards support across a broad range of technologies, from CBRNE detection to emergency responder communications interoperability to cyber security, among other areas.

While DHS is in the early stages of developing its standards strategy and practices, it seems clear that DHS will rely heavily on NIST to help provide the measurements and standards infrastructure supporting the development and implementation of homeland security technology solutions. Furthermore, the recommendations and guidelines for improving the security of federal information systems developed by NIST, under responsibilities outlined in the E-Government Act of 2002, will support DHS's operational need to secure its own systems.

Q7. What provision does the FY 2004 budget request make for managing and archiving the data collected from the climate research activities for agencies under your department? Also, describe the budget's impact on the three major data centers operated by the National Environmental Satellite, Data and Information Service.

A7. NOAA has placed a priority on managing and archiving the vast amount of data collected from our climate research activities. NOAA's Data Centers and its activities to improve data archive, access, and assessment activities are designed to enhance NOAA's capability to accelerate climate deliverables, reduce uncertainty and aid in decision-making at all levels in both the federal and civilian sector. These activities implement the climate portion of the NOAA Strategic Plan for FY 2003–FY 2008.

The FY 2004 Budget Request of $59.4 million for NOAA's Data Centers will maintain support for the current requirement for environmental data management. However, the requirement to manage increased data to meet the new and challenging requirements for climate data and services, necessary to support economic, educational, homeland security, science and transportation needs, increases exponentially. In response to this growing requirement for scientific stewardship of these data, the President's FY 2004 Budget Request includes funding for a critical step in meeting the increased data archiving and access requirements placed on NOAA from current Earth Observing System (EOS) missions, NPP and NPOESS at $3.0 million for EOS Archive and $3.6 million for Comprehensive Large Array-data Stewardship System (CLASS).

NOAA had presented a plan to begin to address the data management issues raised in the House Science Committee, Subcommittee on Environment, Technology, and Standards. Unfortunately, the FY 2003 Omnibus Appropriations did not support the President's request for $3.0 million for the EOS Archive, and reduced the President's request for CLASS by $0.7 million. This has resulted in a delay in NOAA's data management program schedule and increase in the delivery risk to accommodate the need for climate data from NOAA's Data Centers.

Q8. NOAA has begun defining the next generation of satellite systems for weather tracking and forecasting. What steps are being taken to incorporate requirements for the collection of climate-quality data for the support of the Nation's global change research efforts into the instruments to be carried aboard these new satellites, while at the same time supporting the operational requirements of the National Weather Service?

A8. While NOAA's current satellite sensors were designed primarily for application to weather forecasting and short-term phenomena, extensive consideration has, and continues to be given in both the development of the space and the ground components of the next generation of NOAA's polar and geostationary satellite systems. There are a number of actions being undertaken to incorporate climate requirements for future satellite sensors that will satisfy both weather and climate requirements.

- Stringent Requirements Management Programs, designed to formally interface with users and address satellite-based environmental observations, are being used to identify, document and assess specific climate-related requirements for both the future National Polar-orbiting Operational Environmental Satellite System (NPOESS) and GOES–R systems. Through this process, and complemented by dedicated climate workshops, conferences, and meetings, climate requirements from all NOAA Line Offices; other federal agencies, including the interagency Climate Change Science Program (CCSP) and the Committee on Environment and Natural Resources (CENR) Task Group on Earth Observations, and direct users in the climate community are being incorporated. These requirements fall into the categories of observational requirements (i.e., key parameters to be observed), instrument requirements (i.e., calibration, long-term stability) and system requirements (i.e., satellite overlap, orbit stability).
- These climate requirements are entered into the preliminary design of all future platforms and instruments, as done with the weather requirements, to be assessed through numerous trade studies against technical and program cost capabilities and cost benefit analyses.
- These requirements are then included in the final instrument and full space and ground system contracts to insure all accurate observation, transmission, data processing, archiving and user availability requirements are addressed.
- The key climate parameters to be observed include: (1) Solar irradiance, energy radiation balance and clouds (total solar irradiance, spectral solar irradiance, outgoing long wave radiation, net incoming solar radiation, and cloudiness), (2) atmosphere (temperature, water vapor, ozone, aerosols, precipitation, and carbon dioxide), and (3) the surface (vegetation, snow cover, sea ice, sea surface temperature, ocean winds and ocean color). Observation of these climate parameters do not conflict with and in most cases do not increase those parameters required of the operational weather services. Rather, they are a subset of the multitude of atmospheric, ocean and land observations already required for weather and ocean operations.
- However it is the detection of the slow changes in these environmental parameters associated with climate change that places more stringent requirements on *instrument accuracy, stability and precision* that most current sensors do not meet. To make full use of future sensors for the climate application, these requirements are also being taken into consideration during mission and sensor design and in pre- and post-launch testing and characterization.
- Specifically within the next generation polar-orbiting program, NPOESS, calibration, stability, and precision requirements for NPOESS instruments, documented in the Integrated Operational Requirements Document (IORD), were increased to make them "climate class." These changes mean that the calibration of the instruments is very carefully established from the day the instrument is "born" throughout its life in space and that the calibration is traced back to a national standard. The instrument is also stable—it does not change measurement with time (e.g., a 10 degree measurement today will mean the same thing that it did five years ago and five years in the future). These two characteristics are also important for the cross correlation of instruments from one satellite to the next. Precision means that we know precisely what we are measuring. These requirements are included in the instrument contracts and in the contract for the whole system, since they drive a series of test and calibration/validation requirements. These more stringent requirements, while critical for quality climate measurements, also improve the accuracy and application of those same observations needed for weather and ocean operations.
- NPOESS is also planning to fly a dedicated, climate-specific Aerosol Polarimeter Sensor (APS), better able to measure precise aerosol properties (about 10 parameters). These measurements are critical to understanding human and natural impacts on regional and global climate but are also used extensively

in weather operations in areas of air quality, Earth radiation, volcanic plume detection and tracking and aircraft operations.

- Specifically within the development of the next generation NOAA geostationary satellites, GOES–R, climate requirements are being identified through the NESDIS satellite-based Requirements Management Process for assessment in five system developments: three instruments, one spacecraft and one ground system. Like the NPOESS program, in addition to identifying the climate-related observables, the stringent instrument calibration, long-term stability and precision requirements are being incorporated for future trade and cost analyses.
- Due to its high temporal coverage, the geostationary platform is well suited to determine the diurnal component of chaotic processes like clouds and precipitation, which play a large part in the Earth's energy and water budget. Long-term trends and changes in the powerful diurnal cycle can be measured reliably only by a consistently calibrated time-series of daily processes over decades. At the same time this data aids short-term forecasting and warning operations by allowing more accurate locating of potential severe weather areas.
- Advanced Data Collection Systems planned for both NPOESS and GOES–R will continue the function on current NOAA satellites to collect data from buoys, ships, aircraft, and other remote platforms that feed the near realtime databases used for short-term forecasting and warnings but also contribute to the long-term record of environmental observations used for climate analyses.

NESDIS is also currently pursuing several avenues toward improving its use of weather satellites for climate monitoring: 1) increasing its investment in the instrument calibration area, a capstone issue for climate data sets; 2) developing a unified instrument monitoring system to provide information on satellite instrument calibration and performance; 3) with the advice of the National Academy of Sciences, NESDIS is developing a plan for utilizing the observations taken by the operational satellites to generate high quality climate data records (CDRs) that meet the needs of climate data users; and 4) NESDIS is currently developing plans for scientific data stewardship (SDS) of remote sensing observations for climate: These plans include the development of separate climate processing and monitoring systems, and the formation of Sentinel Climate Teams to oversee observing system performance, generation of climate data records, data quality, and archiving issues.

These activities implement the NOAA Program Review Team's recommendations to ensure end-to-end management requirements-based development of NOAA's programs.

Q9. Describe the life-cycle data management plans for the observing systems NOAA intends to deploy during the next decade. How does the plan assure that sufficient resources will be devoted to the collection of appropriate metadata and to the long-term support for archiving of the data sets collected during the operating life of the new observing systems?

A9. The NOAA Program Review Team has recommended that NOAA centrally plan and integrate all observing systems, with acquisition and responsibility for operations and maintenance of systems to be determined on a case-by-case basis. The plan is currently being developed from the overall NOAA observing architecture baseline. All current and short-term activities, as well as validated requirements, have been implemented into the current baseline. All future observing systems will be assessed for validated requirements, alignment with the overall architecture, and plans for utilization of the data. This includes ensuring all archive data are in compliance with metadata standards, as well as meeting archive, access, and retention standards. A cross-cutting team, led by NESDIS, will conduct periodic reviews of all observing systems within the framework architecture. The NOAA observing architecture team has begun the analysis and mapping of resources to observing platforms. This comprehensive review will allow the NOAA team to assess and recommend any changes necessary to the current allocation of resources to ensure appropriate resources are matched to best support the success of the overall observing systems support structure.

Data from these observing systems will be archived in the NOAA Data Centers as outlined in the biennial report on the status and challenges for NOAA's environmental data systems. Over the past few years, NOAA has been implementing a plan to address the entire life cycle of data—from observation and initial data capture to final disposition—implementing an end-to-end data management approach. This includes the development of an architecture for an integrated, national, environ-

mental data access and archive system that incorporates end-to-end data management functions.

NOAA's life cycle data management program considers the following:

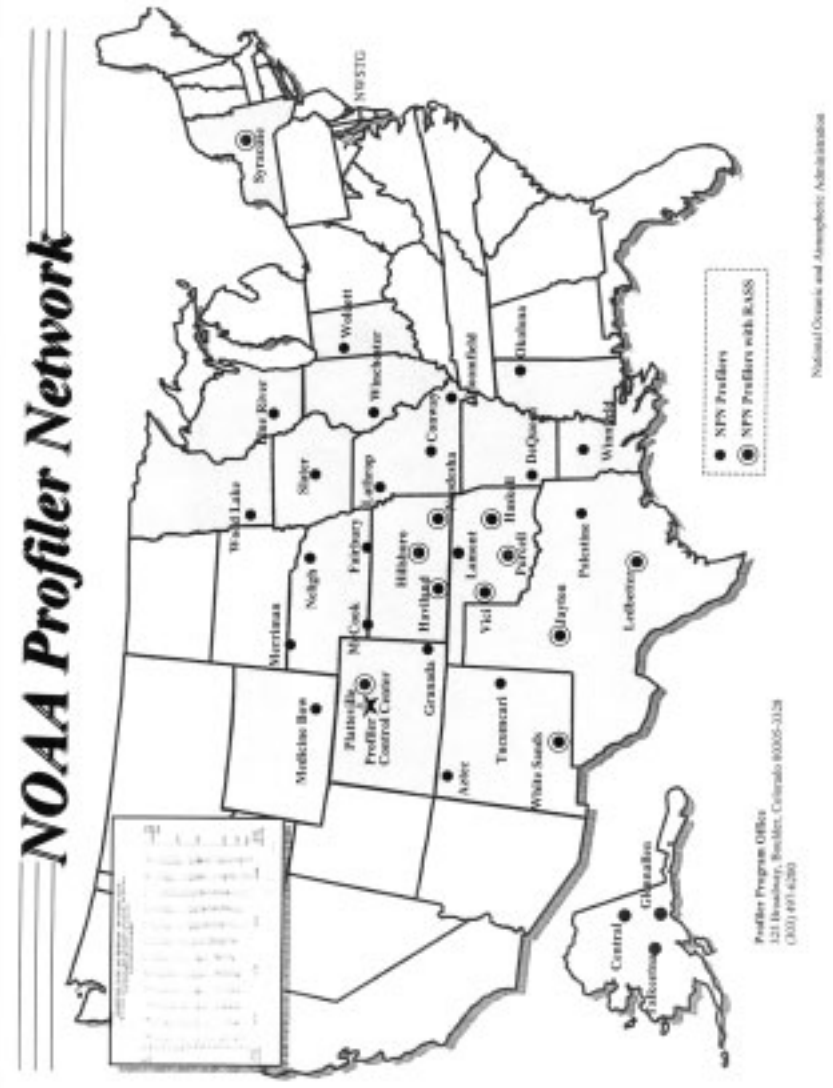
- Observing platforms (i.e., satellites, land stations, ships, aircraft, buoys) and instrument/sensor characteristics;
- Data processing at the sensor platform and on the ground;
- Metadata creation;
- Data capture and delivery systems;
- Data validation and calibration procedures;
- Archive procedures and media migration;
- Data reprocessing to maintain the currency of the data set and to allow new uses of data;
- Data uses and limitations;
- Scientific data stewardship; and
- Dissemination and user access, as appropriate for the data set.

Question submitted by Representative Jerry F. Costello

Q1. Can you please provide a copy of the analysis that was done that led to the National Profiler Network termination in the FY04 Budget Request?

A1.

- There was not an analysis done when the Administration made the decision to terminate the profiler network.
- The Administration has proposed to deactivate 32 radar wind profilers of the NOAA Profiler Network (NPN), located in the central U.S., and a central command and processing center (the Profiler Hub) in Boulder, Colorado, for a savings of $4.15 million (M) per year. Homeland Security and other budget priorities have forced this cost-saving measure.
- This decision was prompted, in part, by the expectation that 30 of the systems would have to be upgraded to transmit at a new frequency, at a cost of $13.5M, a major expense. This is no longer as immediate an issue. A new European Union GPS satellite constellation, called Galileo, has been planned for deployment starting in 2006. International Search and Rescue (SARSAT) equipment will be on all of the new satellites. Since the present profiler frequency is very near that used by the SARSAT equipment, the profilers stop transmitting whenever the current six SARSAT-equipped satellites pass over. Loss of data caused by these overpasses is insignificant. However, with many more satellites in orbit after Galileo is fully deployed, the profilers would essentially be turned off almost all of the time unless their frequency is changed. Since the Administration made its decision, it has now been learned that the Galileo program will be delayed at least a couple of years beyond 2006.


NOAA Profiler Network
NPN Profilers
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ANSWERS TO POST-HEARING QUESTIONS

Responses by Rita R. Colwell, Director, National Science Foundation

Questions submitted by Chairman Boehlert

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

Q1. The President's fiscal year 2004 budget request represents a significant improvement over prior year requests with regard to directorate breakdown, full life-cycle costs, and prioritization of the "new start" projects in the Major Research and Facilities Construction (MREFC) account. However, the budget does not include the criteria used to rank these projects and the relative value these criteria were given in establishing the prioritized list. This information is required to be annually submitted to Congress before any funds can be obligated from the MREFC account. Please provide us with this information. Also, please clarify how new projects will be reviewed and ranked, how they will be incorporated into the existing prioritized list, and when and how the revised list will be transmitted to Congress.

A1. In the FY 2004 budget request, $202.33 million in funding is requested for seven ongoing MREFC projects. No funds were requested for new start projects. This is consistent with current National Science Board policy, which requires that NSF give first priority to projects that have been started but not completed. The FY 2004 budget request identified three new starts for initiation in FY 2005 and FY 2006. In priority order, these are:

Scientific Ocean Drilling in FY 2005;

Rare Symmetry Violating Processes in FY 2006; and

Ocean Observatories in FY 2006

This specific set of new starts can be viewed within the broader context of how NSF identifies, reviews, selects and prioritizes large facility projects (i.e., the process that NSF used to prioritize these three new projects).

The Broader Context

In identifying new facility construction projects, the science and engineering (S&E) community, in consultation with NSF, develops ideas, considers alternatives, explores partnerships, and develops cost and timeline estimates. By the time a proposal is submitted to NSF, these issues have been thoroughly examined.

Upon receipt by NSF, large facility proposals are first subjected to rigorous external merit review, focusing on the criteria of intellectual merit and the broad (probable) impacts of the project. Only the highest rated proposals—i.e., those that are rated excellent on both criteria—survive this process and are recommended to an MREFC Panel comprised of Assistant Directors and Office Heads, serving as stewards for their fields and chosen for their breadth of understanding, and chaired by the Deputy Director.

The MREFC Panel uses a two-stage process. First, it selects the new start projects it will recommend to the Director for NSF support in a future NSF budget, based on a discussion of the merits of the science and engineering within the context of all research and education that NSF supports. Second, it places these recommended new start projects in priority order.

In selecting projects for future support, the Panel considers the following criteria:

- Significance of the opportunity to enable frontier research and education.
- Degree of support within the relevant S&E communities.
- Readiness of project, in terms of feasibility, engineering cost-effectiveness, interagency and international partnerships, and management.

Using these criteria, projects that are not highly rated are returned to the initiating directorates, and may be reconsidered at a future time after the questions raised by the panel have been addressed. The Panel then places highly-rated projects in priority order. This process is conducted in consultation with the NSF Director. The MREFC Panel and the Director use the following criteria to determine the priority order of the projects:

- How "transformative" is the project? Will it change the way research is conducted or change fundamental S&E concepts/research frontiers?

- How great are the benefits of the project? How many researchers, educators and students will it enable? Does it broadly serve many disciplines?
- How pressing is the need? Is there a window of opportunity? Are there interagency and international commitments that must be met?

These criteria are not assigned relative weights, because each project has its own unique attributes and circumstances. For example, timeliness may be crucial for one project and relatively unimportant for another. Also, while a specific project may not broadly serve many disciplines, it may be the sine qua non of certain areas of science. Additionally, the Director must ensure the following have been addressed: the impact of a proposed facility on the balance among scientific fields, the importance of the project with respect to national priorities, and possible societal benefits.

In August the Director presents the MREFC priorities, including a discussion of the rationale for the priority order, to the NSB, as part of the budget process. The NSB reviews the list and either approves or argues the order of priority. As part of its budget submission, NSF presents this rank-ordered list of projects to OMB. Finally, a prioritized list of projects is submitted to Congress as part of the President's request.

The Specific Case

The three new start projects cited in the FY 2004 budget request are considered highly meritorious by the S&E community, the NSF and the NSB.

The Scientific Ocean Drilling (SOD) Project was ranked as the highest priority because delaying initiation of the project until FY 2006 would greatly impact the existing community of researchers, and because of the significant level of complementary international effort and planning already underway. This project will charter and modify a drill ship that will work in a new scientific program (Integrated Ocean Drilling Program (IODP)), in concert, and complementary to, a deep drilling vessel being constructed and operated by Japan. Some of the drilling to be done from the SOD vessel will be used to guide and plan drilling from the Japanese vessel, which is scheduled to begin operations in 2007. Additional international members who help finance our existing ocean drilling program are prepared to join the new program, but will have trouble maintaining and committing their financial contribution if drilling from the SOD vessel is delayed until 2007. At present, the Japanese vessel has been constructed and is undergoing outfitting. If the U.S. does not meet its commitment, there will be no conventional drill ship capabilities for use in the IODP, and critical studies of climate change and the ocean biosphere will be jeopardized.

The two remaining new start projects, Rare Symmetry Violating Processes (RSVP) and Ocean Observatories, were judged to be of equal value, but for different reasons. RSVP ranked second, primarily for reasons of balance across scientific fields and timeliness. RSVP is very well designed, well reviewed, and addresses important scientific questions that have the potential to transform our basic understanding of the universe. There are, as with SOD, performance and cost risks associated with delays. The host laboratory, Brookhaven National Laboratory, would be forced to lay-off key staff and then rehire and/or replace them following an extensive shutdown of beams planned for use by RSVP; and, the international collaborators may have difficulty maintaining (as SOD will) the large financial contributions currently committed to RSVP, on order of $10 million (U.S.). Nevertheless, these considerations do not outweigh the funding and stewardship issues represented in SOD. If initiated in FY 2006, RSVP can still be implemented successfully and make major contributions to science.

The Ocean Observatories project includes an expanded network of coastal observatories; several relocatable deep-sea observatories based around a system of buoys; and a regional, deep water observatory consisting of interconnected sites on the seafloor that span several geological and oceanographic features and processes. It will enable a large group of researchers to perform ocean science in new ways. It was ranked third among the new start projects because it is not as urgent as SOD or RSVP, and again, for reasons of balance across scientific fields.

CYBER SECURITY RESEARCH AND DEVELOPMENT ACT

Q2. The events of September 11, and subsequent computer viruses and worms have highlighted the vulnerability of our nation's critical infrastructure to attacks upon our computer networks. Congress responded by enacting P.L. 107–305, the Cyber Security Research and Development Act. This legislation authorized new computer security research programs at the National Science Foundation (NSF). What portion of the fiscal year 2004 budget request for NSF will be devoted to implementing this Act and what is your schedule for implementation? The Act

also makes NSF the lead federal agency for cyber security research and development. How do you intend for NSF to carry out its role of ensuring that there is an adequate and coordinated program in this field?

A2. The FY 2004 budget request for NSF includes $51.18 million for programs that directly support the Cyber Security Research and Development Act. In FY 2003, NSF is actively implementing the Act within its available resources.

Schedule for Implementation:

NSF is already implementing elements of the Act in FY 2003 at a level of $26.18 million and this positions NSF to plan for an investment level of $51.18 million in FY 2004. NSF workshops are being held with a focus on implementing P.L. 107–305.

The Computer and Information Science and Engineering (CISE) Activity is targeting research and education efforts that further the development and understanding of trustworthy cyber systems, in areas such as data and application security, networking security, embedded and hybrid systems and operating systems and compilers. A significant part of this effort will be funded by reallocating funds from programs such as operating systems and compilers, database systems and networking research.

NSF is expanding its efforts in cyber security. The Foundation has leading national experts on staff in this area. NSF has an internal working group that meets regularly to coordinate and plan NSF efforts. NSF has already set in place practices to assure that awardees will be aware of requirements in Sec. 16 of the Act (Grant Eligibility and Compliance with Immigration Laws).

Coordination Among Federal Agencies:

NSF actively consults with other agencies through several venues.

- NSF staff co-chair the High Confidence Software and Systems area of the Networked Information Technology Research & Development (NITRD) coordination activity that coordinates research among 12 agencies.
- NSF actively participates in the interagency Infosec Research Council, which is an informal group that meets monthly on information security matters. Participants include representatives from DARPA, DOD, DOE, NIST, FAA, the Nuclear Regulatory Commission, and others.
- NSF staff participated recently in a review of NSA R&D programs for information assurance.
- NSF staff are playing an active role in the National Security Telecommunications Advisory Committee's R&D exchange to facilitate discussion of cyber and software issues.
- The NSF Assistant Director for CISE has been a principal on the Critical Infrastructure Protection committee.
- NSF's CISE directorate has been sponsoring workshops that include academic, industry and government personnel who are active in cyber security research.
- Working with the State Department has also led to discussion on common research interests with the European Union.

The coordination groups mentioned above are all avenues for participating agencies to become aware of the programs of other agencies; this coordination promotes synergy and reduces duplication, filling gaps in important research areas, and increasing awareness of research among agencies that can be utilized to improve results at other agencies.

Questions submitted by Representative Ralph M. Hall

CYBER SECURITY

Q1. Last year the President signed into law the Cyber Security R&D Act (P.L. 107–355), which authorized significantly increased funding for cyber security research, education, and faculty development programs to be implemented at NSF. To what extent does the FY 2004 budget request implement the provisions of the statute, and what can you say about the priority we may expect to see for such activities at NSF in future budgets?

A1. Cyber security is a priority for NSF and effort is focused in the Computer and Information Science and Engineering Activity. NSF agrees with the findings of P.L.

107–305 and among federal agencies, is well positioned to undertake the basic research and related education activities necessary to address these growing concerns.

For research activities, NSF has requested $35.0 million in FY 2004. Approximately $27.0 million is allocated to cyber security research addressing Sec. 4(a) of the Act. An estimated $8.0 million will support multidisciplinary groups and Information Technology Centers in the Information Technology Research (ITR) program under the medium and large awards categories; the funded centers are selected with criteria that address Sec. 4(b).

NSF has also requested $16.18 million specifically for capacity building in cyber security in the Scholarships for Service program; that program supports programs at 15 colleges and universities in accord with Sec. 5(a) of the Act.

Related to Sec. 5(b) of the Act, NSF's Advanced Technology Education (ATE) program, which targets 2-year institutions, provides over $3.0 million in computer technology projects each year. As computer security is increasingly introduced in curricula, in FY 2004 at least $500,000 will be devoted to awards with a strong focus on cyber security training and with security awareness and practices incorporated in their projects.

Graduate Research Fellowships are open to support for students seeking research training in cyber security areas, fully implementing Sec. 5(d).

NSF has a number of active awards that address the urgent national need for the training of students and development of faculty in cyber security areas as authorized in Sec. 5(e) of the Act. For example, NSF has innovative programs that integrate faculty development and development of new college curricula for tribal, minority and other institutions. Indiana University of Pennsylvania is supporting faculty and curriculum development in Pennsylvania, West Virginia and Ohio. An award to the Naval Postgraduate School is supporting a two year series of workshops in information assurance targeted to college level educators. The University of Idaho is supported as a Research Experiences for Undergraduates site, which will focus on intrusion detection and system protection for networked systems; the project will engage 42 students in research experiences over its duration. These, and other awards, address the demand for cyber security capacity building through proven strategies and will be further developed to assure responsiveness to Sec. 5(e) of the Act. NSF is currently examining activities for capacity building and will report to the Committee in the near future.

NSF's ITR priority area continues to evolve and cyber security will be a critical element. NSF will address the demand for cyber security research with a portfolio of individual, group and small center awards that address a range of fundamental studies that research new approaches to security through interdisciplinary projects that can explore and test security concepts in realistic settings.

GENDER EQUITY & PERSONS WITH DISABILITIES

Q2. The FY 2004 budget proposal for the Program for Gender Equity is cut by five percent and the budget for the Program for Persons with Disabilities is flat. There is wide agreement on the importance of attracting more individuals from groups currently under-represented in science and engineering, particularly through efforts to turn on young people to science and technology. Recent NSF assessments of these two programs found both to be valuable and effective. What then is the rationale for these funding decisions?

A2. The NSF has and will continue to maintain the strength of its program emphasis on attracting individuals from groups currently under-represented in science and engineering. In fact, this issue is increasingly being addressed in programs throughout the Foundation.

One example of an increase in funding that specifically focuses on women is ADVANCE. Over the past three budget cycles the ADVANCE budget has grown from $9 million in 2001 to $17.14 million in 2003. The development of ADVANCE, a program that complements the Program for Gender Equity, ensures that support for improving gender representation is now spread throughout the Foundation. ADVANCE supports projects that address the organizational factors that have inhibited women's progress up the ladder of academic science and engineering careers. Through awards for individual researchers, for leadership teams, and for institutional change, ADVANCE seeks to build on the Foundation's investment in and commitment to gender equity in order to engage the widest breadth of intellectual talent available to the Nation.

The budget for the Program for Persons with Disabilities (PPD) allows NSF to provide continuity to currently funded centers. Furthermore, the PPD program has developed a national infrastructure that more regionally responds to the needs of persons with disabilities. While there has been success with the current large center

model that has as a complement one or more additional smaller centers, it was felt a national regional structure would be more reflective of the growing need across the country.

Because it is not a new program, but rather an alternative approach to a current construct, the budget will sustain the regional centers, a series of new planning grant sites, and focused research sites. Each site is working to develop best practices in addressing issues for individuals with disabilities.

STIPENDS FOR GRADUATE STUDENTS

Q3. NSF has been increasing the size of stipends for graduate fellowships and traineeships and is proposing to raise the stipend to $30,000 per year in this budget request. What has been the effect on numbers of applications for fellowships and traineeships as a result of increasing stipends, and in particular, the effect on the number of applications from individuals from under-represented groups? Have you assessed the effectiveness of your outreach efforts to increase applications from minorities following termination of the Minority Graduate Fellowship Program? That is, what factors seem most effective for increasing minority applications? (EHR)

A3. Over the past five years (1998–2003), the graduate stipend has increased from $15,000 to $27,500 in three NSF Programs: NSF Graduate Research Fellowships Program (GRF), Integrative Graduate Education and Research Traineeship Program (IGERT), and NSF Graduate Teaching Fellows in K–12 Education (GK–12).

Dramatic increases in the number of applications and proposals have occurred in GRF and IGERT, respectively. The GRF Program reviewed 5,233 applications in 1998 and 8,199 in 2003, a 57 percent increase. The largest increases in applications have occurred when the stipend has been increased significantly, as has been the case in the past three years. The number of applications from under-represented minorities (URMs) has also increased in number over the past three years, from 516 in 2000 to 820 in 2003. These numbers are also beginning to compare favorably with the last three years of the Minority Graduate Fellowship Program (MGF): 697 applicants in 1998, 762 applicants in 1997, and 869 applicants in 1996.

IGERT experienced a very significant increase in pre-proposals between 2002 and 2003: 254 to 425, a 67 percent increase. To increase the current 10 percent minority representation in Trainee participation, the program has awarded a grant to enhance recruitment and mentoring components for all 100 IGERT sites. The goal is to increase the participation to 20–25 percent minorities. The GK–12 program has experienced a steady number of letters of intent for 2001 and 2002.

After the Minority Graduate Fellowship Program (MGF) ended, NSF dramatically increased its outreach efforts. Two notable effects have resulted. First, the trend since 1995 (which includes the last few years of MGF) of decreasing portion of applications from URMs has ended. The URM portion of applications has leveled off for the past two years and NSF expects increasing proportions in upcoming years. Second, since 1998, the success rate for URM applicants has risen to a level not far below the overall rate. The URM portion of applications has been approximately 11 percent for the past few years and NSF expects its outreach will result in increasing portions in upcoming years. As a comparison, in 1993, 17 percent of GRF applicants (virtually all MGF applicants) were URMs. Since 1998, when it was 5.9 percent compared to 18.8 percent overall, the success rate for URM applicants has risen, and in 2003, it surpassed the overall success rate for the first time. The URM success rate/overall success rate for the past five years of the consolidated competition is: 1999: 13.6/18.8, 2000: 17.2/18.4, 2001: 12.3/16.2, 2002: 10.1/13.7, 2003: 13.7/11.6. We feel that the rapid increase in URM success rate is in part attributable to increasing outreach and improvements in the review process that encourage a more compete evaluation of each application.

The factors that seem most effective for increasing minority applications and increasing their success in the GRF program are: a) disseminating information about the program to potential applicants and to institutions that don't traditionally participate in the program, b) sharing information with these potential applicants about writing applications that reflect their abilities, and c) targeting faculty in their roles as mentors, references, and providers of undergraduate research opportunities. The program is paying particular attention to these factors in its outreach to Minority Serving Institutions. One sign of progress is that two of the 2002 GRF awardees are currently affiliated with a Historically Black College or University that never hosted any GRFs previously. The GRF program is also working with other NSF programs to develop further strategies that increase the success rate of URM applicants.

GRADUATE RESEARCH ASSISTANTS

Q4. Does NSF have a goal for the proportion of fellowships and traineeships relative to graduate research assistantships, which are funded under individual research grants? Does NSF have a policy of encouraging universities to provide graduate assistantship stipends roughly in line with fellowship and traineeship stipends?

A4. NSF does not have a goal regarding the proportion of fellowships and traineeships relative to graduate research assistantships. NSF supports about 4500 students on its three graduate programs, IGERT, GK–12 and Graduate Research Fellows. Individual investigators determine the number of graduate research assistants through their research grants. Currently, the number of those students supported is about 21,000–22,000.

NSF does not have a specific policy regarding stipend levels for graduate research assistants. The stipend levels for graduate students in our fellowship programs are meant to attract the best U.S. citizens to science, technology, engineering, and mathematics, and have been successful in doing so. Applications to the Graduate Research Fellowship program have risen in direct proportion to the increasing stipend level for the last three years. Although there is no direct link between the stipend levels for our graduate students and those on research grants, NSF anticipates that the research community takes NSF stipend levels into consideration in determining their own salary structure for graduate students.

POSTDOCTORATE SUPPORT

Q5. NSF has established an NSF-wide Working Group on Postdocs to provide coordination of NSF support for postdocs and the identification of agency-wide policies and requirements. What progress has been made in developing NSF policies for postdoc support and should we expect these policies to draw upon the comprehensive recommendations of the 2000 National Research Council report, "Enhancing the Postdoctoral Experience"? Are there reasons NSF should not institute terms and conditions in its grants to regulate the treatment of postdocs consistent with NSF-wide policies?

A5. It is estimated that NSF will support approximately 6,060 postdocs in FY 2003. About 200 of these postdocs are supported through targeted postdoc fellowship programs, with the remainder supported on research grants. For the postdoc programs, NSF has explicit requirements regarding the postdoc financial and career development support as stated in the individual program announcements. These program requirements address issues raised in the NRC Report *Enhancing the Postdoc Experience* and draw on the recommendations of that report. In addition, the NSF Postdoc Working Group is considering several issues concerning postdoc compensation and other support to inform planning for the FY 2005 budget.

For those postdocs supported on research grants, the submitting institution requests the postdoc salary and benefit package, and develops the plan for the postdoc career development. Although these aspects of the postdoc support are subject to merit review by peer reviewers as well as by NSF staff, there are variations by institution consistent with their policies and practices.

In summary, NSF is addressing issues raised in the NRC and other reports to improve the postdoc experience through 1) merit review of proposals with increased emphasis on the Broader Impact review criteria, 2) development of NSF postdoc programs that further address issues raised in these reports, 3) development of national models of exemplary practices for postdoc experiences, and 4) planning for the FY 2005 budget.

CYBERINFRASTRUCTURE

Q6. The FY 2004 budget request includes $20 million for a new Cyberinfrastructure subactivity in the computer science directorate. Please relate this request to the recommendations of the recent report of the blue ribbon advisory committee on cyberinfrastructure. In particular, the blue ribbon committee recommends an infusion of more than $1 billion per year for NSF, including fundamental and applied research to advance cyberinfrastructure and acquisition and operation of advanced facilities for the research community. What aspect of the blue ribbon committee's recommendations does this new budget proposal address? In general, has NSF accepted the recommendations of the blue ribbon panel and will we see future budget proposals in line with the recommendations?

A6. The Advisory Committee on Cyberinfrastructure, sometimes referred to as the blue ribbon panel on cyberinfrastructure, has reported its findings and recommenda-

tions in "Revolutionizing Science and Engineering Through Cyberinfrastructure" available on the World Wide Web at *http://www.cise.nsf.gov/evnt/reports/FRONTMATTER_all.pdf*. NSF views this report as an important document formulating a vision for cyberinfrastructure, justifying the investment through the ability to conduct new kinds science and engineering, and defining innovative means for scientists and engineers to fully exploit the opportunities provided by the availability of state-of-the-art sensors, massive data resources, and visualization. The committee sought the advice of a very broad group of leading scientists and engineers across the nation and found consensus on the importance and value of cyberinfrastructure investments.

NSF plans for cyberinfrastructure are to build on recent and current investments in Terascale facilities, and to integrate these with other investments in Partnerships for Advanced Computational Infrastructure (PACI), Advanced Networking Infrastructure, and other activities. In FY 2003, the Terascale facilities will begin operating as a single distributed facility with five main sites for computation connected by a high-performance network backplane. In 2003 NSF will connect additional existing resources, such as computers, disciplinary databases, or leading edge scientific visualization facilities to the Terascale system. The FY 2003 awards will focus on making existing resources accessible to the full Terascale user community. Sharing of resources, interoperability of data, and new shared capacities for research and education will begin to demonstrate the potential of cyberinfrastructure to support new types of scientific and engineering analysis, permit a wider community of U.S. scientists and engineers to access the most advanced resources, and demonstrate the validity of the cyberinfrastructure report vision. A tighter integration of existing PACI facilities and network infrastructure investments with the Terascale facility is also expected.

In FY 2004, NSF has requested $20 million for cyberinfrastructure investments. NSF will build on investments made in FY 2003 and consider development of new resources to become part of the emerging cyberinfrastructure. The investments of 2003 and 2004 will be consistent with the report insofar as NSF is beginning to explore the range of cyberinfrastructure opportunities.

Beyond FY 2004, NSF expects that the budget for cyberinfrastructure will grow and be closely coordinated across all of the directorates. As cyberinfrastructure grows, funding requirements will increase, particularly in development of new resources such as sensors nets, shared visualization and scientific collaboration capabilities, innovative software resources to support new techniques for modeling and simulation, inter-operable database resources, and research enablers for new capabilities in cyberinfrastructure.

PLANT GENOME RESEARCH AND THE DEVELOPING WORLD

Q7. The recently enacted NSF authorization law includes an authorization for basic genomic research related to crops grown in the developing world. Within NSF's proposed plant genome research activities for FY 2004, are there any plans to support work related to this new authority, and if not, can we expect to see provision for such research in future budget requests?

A7. As authorized in H.R. 4664, Sec. 8, 3C, the Plant Genome Research Program is to support research on crops grown in the developing world. Since all crop plants are genetically similar, information and research tools developed in one plant species can be applied to all crops including those grown in the developing world. For example, projects supported by NSF have identified genes involved in plants' responses to environmental stress such as salinity, drought and frost. Moreover, genes important for plants' resistance to major plant pathogens are being identified. This information and these research technologies can be and are being applied by U.S. scientists to improve crops grown in the developing world. In addition, NSF supports genomic research on rice, sorghum, corn and potato, some of the most important crops in the developing world.

Taking advantage of the outcomes from the NSF supported research, U.S. investigators are collaborating with scientists in developing countries to translate the basic research findings into improved crop production in the developing world. NSF encourages these networking/coordination efforts by supporting workshops and research collaborations. Specific examples include:

(1) A Plant Genome grantee helped the International Rice Research Institute in the Philippines to set up a lab to use a novel method, which rapidly identifies genetic mutations of agronomic importance, and will help breeders improve rice;

(2) NSF supported an international Musa (banana and plantains) genomics workshop, which led to the establishment of the Global *Musa* Genomics Consortium with members from Africa, Central and South America, and India;

(3) NSF supported researchers from the University of Wisconsin, Madison are collaborating with scientists from CIMMYT, the International Maize and Wheat Improvement Center in Mexico, on the study of the evolution of the maize genome; this research will help scientists identify agronomically beneficial traits in maize, which is leading to hardier crops; and

(4) NSF supported PIs working on various cereal crops are involved in the U.S. A.I.D. sponsored activities to develop the Cereal Genome Initiative and are providing opportunities for international collaborations with scientists in developing countries.

NSF is in contact with the U.S. A.I.D. to coordinate our efforts to increase capacity for plant genome research in developing countries. In FY 2004, the NSF Plant Genome Research Program plans to encourage inclusion of training of scientists from developing countries in proposals submitted to the Program.

NSF BUSINESS ANALYSIS

Q8. The FY 2004 budget proposal for the NSF Salaries and Expenses account includes a request of $42.7 million for information infrastructure acquisitions, an amount that is 70 percent above the FY 2003 request for this purpose and 160 percent above the FY 2002 appropriations level. NSF has entered into a three-year, $12 million review of NSF's business processes and supporting human capital and enabling technologies. One outcome is to be an integrated enabling technologies plan. Why does this large budget growth for information infrastructure for internal NSF operations precede the completion of the enabling technologies plan? Why do you believe that the technologies you are acquiring will be consistent with the recommendations from the management study?

A8. The National Science Foundation (NSF) is moving in step with—not ahead of—the Business Analysis. All planned information technology investments are consistent with the goals and strategies outlined in the NSF Administration and Management Strategic Plan. NSF's Chief Information Officer (CIO) and the Director of the Division of Information Systems, who also serves as the Deputy CIO, are participating actively in the current Business Analysis and are leading that part of the Analysis focusing on the Technologies and Tools needed to make improvements in agency business processes possible. The CIO is primarily responsible for defining NSF's information technology (IT) strategy, plans and developing the annual IT budget. The Budget Request for FY 2004 and subsequent years will remain closely aligned with the results of the Business Analysis and with the enabling technologies plan as it evolves. The CIO and Deputy CIO serve on the Business Analysis Steering Committee to assure integration and coordination of near-term plans and investments with longer-term study recommendations. Bi-weekly meetings with the Technology study sub-team, monthly meetings of Business Analysis leads, and frequent Steering Committee meetings are management processes established to assure effective integration and coordination of study activities and information infrastructure investments. Interim deliverables are required (by design) throughout the study and are being used to guide and prioritize near-term information infrastructure investments. This iterative development approach for the enabling technologies plan results in a series of interim deliverables, near-term opportunities and priorities, and plans that are refined to increasing levels of detail and specificity throughout the study. The initial technology framework and suite of interim deliverables will be used to guide investments and allow the deployment of high priority infrastructure improvements and capabilities while a more detailed plan and architecture are formulated over the three year study.

Another key factor ensuring alignment between NSF's requested IT investments and the results of the on-going Business Analysis is that NSF has placed great emphasis on developing an overall Enterprise Architecture, which is captured in the Business Analysis. The Enterprise Architecture is consistent with NSF's goals and operational priorities and is designed to support changing business practices and associated workforce needs, as well as technology advances.

New investments are planned and evaluated within the context of the Enterprise Architecture. Documentation of the current Enterprise Architecture is currently underway and interim deliverables are being used as a framework to identify and evaluate near-term investments in applications and infrastructure.

Consistent with the NSF Administration and Management Strategic Plan, planned investments in the FY 2004 Request continue NSF's investment in the next generation of electronic grants and human capital capabilities. These requirements were identified in the initial phases of the Business Analysis and are highlighted in the NSF Administration and Management Strategic Plan. The Request also provides resources to transition to the new government-wide mandated electronic government initiatives such as e-Grants, e-Payroll, and e-Human Resources. One internal e-Grants service that is being implemented is the Electronic Jacket, which is being used to learn how to evolve from a paper-based automated environment for internal processing of proposals and awards to a role-based, integrated and information-based workflow approach. This is a path finding project to highlight requirements and technical approaches for the longer-term and end-to-end Proposal Review and Award Management Information System (PRAMIS) initiative that is being defined as part of the Business Analysis study.

The FY 2004 Request includes prudent infrastructure investment to support increased operating costs and day-to-day IT services. Proposal receipt is up 28 percent in FY 2003 (to date) from the same time last year. Help Desk call volume for university customers and NSF staff is averaging 8,000 calls per month and is continuing to increase. Additional investments in technology applications, data center, and network resources are needed to sustain these increases and support an effective electronic workflow. Following several years of level funding, the Foundation's basic IT infrastructure is badly in need of upgrading, with some critical servers and equipment that have been in service for as long as six years or more. In a fully electronic environment, redundancy and backup for critical services (such as Internet Service, major systems and network servers) are required to assure consistent, reliable service. NSF's modernization plan includes critically needed investments to replace and establish redundancy for web and application servers, network servers, e-mail servers and storage capacity. In addition, infrastructure investments include costs to maintain a balanced security program, operational security, including 24×7 intrusion detection services, penetration tests, disaster recovery tests and additional security controls. All of these investments are needed to meet current service requirements and provide a more stable foundation for future capabilities that will be identified through the Business Analysis study.

Careful planning and integration of near-term planning with the longer-term study is already resulting in more informed decision-making and investments. The Request level reflects our commitment to a multi-year strategy for improving the IT infrastructure and providing the tools needed to support today's electronic business processes and tomorrow's requirements emerging from the Business Analysis.

COST SHARING POLICY

Q9. NSF recently clarified its cost sharing policy for research awards to make clear that any reduction of 10 percent or more of the cost proposed for a grant must be accompanied by a corresponding reduction in the scope of the project. The purpose of the new rule is to prevent NSF program officers from informally pressuring applicants into high levels of cost sharing in order to receive an award. What steps have you taken to ensure that this directive is enforced? Are committees of visitors formally instructed to look into this when they review grant folders?

A9. The National Science Board revisited NSF's cost sharing policy in the Fall of 2002 and these discussions resulted in a revision to the NSF cost sharing policy. This revision was implemented by Important Notice 128, *Revision of the NSF Cost Sharing Policy,* dated January 24, 2003 and the policy takes effect on April 1, 2003. The Important Notice can be accessed electronically at: *<http://www.nsf.gov/bfa/dga/policy/docs/in128.pdf>.* NSF has taken several steps to ensure that both internal staff and the external community are aware of and understand the impact of this important change.

The principles established in Important Notice 128 will be incorporated in upcoming revisions to NSF proposal and award policy documents. New program solicitations that contain cost sharing requirements will be carefully reviewed for compliance with the revised policy prior to issuance. In addition, a comprehensive set of Frequently Asked Questions (FAQs) has been developed on the revised cost sharing policy *<http://www.nsf.gov/bfa/dga/policy/docs/csfaqs03.pdf>.* These FAQs are posted on the NSF web site for use by the external community, and a separate set available on the internal web site includes questions that are pertinent for use by NSF staff. As additional questions are posed by NSF staff and the grantee community regarding the revised policy, the FAQs will be updated accordingly.

Important Notice 128 makes it very clear that, unless a program solicitation specifically requires cost sharing, proposers should not include cost sharing amounts on Line M of the proposal budget; and, if the solicitation does require it, they should not exceed the cost sharing level or amount specified in the solicitation. In order to more fully ensure the concept of cost sharing as an eligibility rather than a review criterion, the FastLane system is being modified to mask the cost sharing line item on the budget from peer reviewers during the review process.

In addition to disseminating the revised policy via various electronic forums, NSF staff will also be discussing the revised policy in a number of external outreach events scheduled for this Spring. In order to ensure that NSF staff understand and are well versed in the revised cost sharing policy, the Division of Grants and Agreements has been conducting outreach with program staff at Divisional Staff meetings to discuss application of the new cost sharing policy to NSF programs. While NSF is confident that the steps outlined above will provide both NSF staff and the external community with the information they need to understand and abide by the revision, NSF also has an e-mail alias *(costsharing@*nsf.gov) to which one can submit details if a particular program is not in compliance with the revised cost sharing policy. This alias is monitored by the NSF Policy Office staff and all messages are held in the strictest confidence. The matter is looked into and, if necessary, the cognizant Division Director or Assistant Director is contacted to resolve the incidence of noncompliance. NSF will continue to evaluate compliance with the revised policy after it takes effect in April 2003, but have confidence that the mechanisms will address issues related to implementation and enforcement of the cost sharing policy.

EARTHSCOPE, HIAPER, NEON AND GLOBAL CHANGE

Q10. NSF's budget request is calling for a "60 percent increase in major research equipment and facilities construction," including EarthScope, the High-performance, Instrumented, Airborne Platform for Environmental Research (HIAPER), and the National Ecological Observatory Network (NEON). How are these new observing facilities/networks coordinated with other climate and other global change research observing systems, and how do they contribute to U.S. commitments to build observing systems to identify climate and other global changes? Have the requirements for the instruments to be deployed in your proposed observing systems been evaluated to assure that they will provide data of sufficient quality to support the Nation's broader global change research efforts in addition to the needs of the scientists proposing the particular experiments?

A10. EarthScope will enable the study of solid earth systems and does not have components that are designed to address the climate and global change observing systems. However, scientists interested in the study of atmospheric water vapor and ionospheric total electron content have begun to utilize existing continuous Global positioning System (GPS) data, such as that to be generated by the extensive GPS network planned for EarthScope. The EarthScope GPS data will be state-of-the-art and will be openly accessible to all users.

The need for new, airborne research platforms was established in the late 1980s. The High-performance, Instrumented, Airborne Platform for Environmental Research (HIAPER) project has been designed to fill a niche in the national airborne science fleet, with HIAPER's operational characteristics developed in consultation with the national and international community to insure that scientific requirements would be met. NSF is a key partner in three interagency committees on airborne science and aircraft policy, facilitating coordination of research activities with partner agencies. NSF observing facilities, including HIAPER when it becomes operational, have and will continue to support interagency and international programs in weather and climate research.

Initial instruments developed for HIAPER will be based on the results from a workshop, attended by approximately 200 researchers from around the world. The workshop identified the highest priority science issues and instruments will be developed to address these issues, at least to the level of funding available. Although the construction of HIAPER includes development of a base suite of instruments, instrumentation for HIAPER will continue to be developed throughout the operational life of the platform to meet specific science requirements, providing the flexibility to ensure that HIAPER is always positioned to meet emerging research needs.

The NEON network of research observatories will complement other efforts to study climate and global change by providing, through interdisciplinary research infrastructure and protocols, evidence of the nature and pace of biological change. Examples of biological change that could be addressed with NEON include (a) biogeochemical imbalances, (b) dynamics of carbon cycles, (c) emerging infectious diseases,

(d) potential for and impact of invasive species, (e) dynamics of increases or decreases in biological diversity and in ecosystem functions, and (f) causes and consequences of coupled human-natural system dynamics. Several workshops have spoken to the issue of assuring that NEON data is of appropriate kind and quality to be pertinent to climate/global change research in general, although details are appropriately finalized through formal proposals and a rigorous peer review process.

MANAGEMENT OF DATA FOR THE NEW OBSERVING SYSTEMS

Q11. Describe the life-cycle data management plans for each of the new observing systems NSF proposes to deploy over the next decade. How does the plan assure that sufficient resources will be devoted to the collection of appropriate metadata and to the long-term support for archiving of the data sets collected during the operating life of the new observing systems?

A11. The consortia that will construct the EarthScope facility has developed an extensive life-cycle data management plan, including community-generated requirements for metadata and long-term data storage. These NSF-supported consortia have been in existence for more than 15 years and are committed to continue their highly successful permanent data storage and open access indefinitely. They are aided in this task by rapid advances in information technology, which make data storage and retrieval more efficient and less costly each year.

Responsibility for HIAPER data management falls to several organizations. For routine instruments, on-board HIAPER data management is the responsibility of HIAPER's operator, the National Center for Atmospheric Research (NCAR) and the University Consortium for Atmospheric Research (UCAR). The Research Aviation Facility at NCAR collects, maintains and archives data from instruments in its stable, and UCAR's Joint Office for Science Support collects, maintains and archives data from a broader suite of instruments. Data from researcher-supplied instruments is generally maintained and archived by the researcher at his or her home institution. The great majority of instruments that will fly on the HIAPER platform will be developed by individual researchers to address specific needs.

Through NEON workshops, the community has stressed that each observatory must conduct quality assurance/quality control (QA/QC) of the scientific data collected as an integral part of the observatory. Proposals for NEON sites will have to include a detailed description of data gathering, quality and management, while the NEON Coordinating Unit will assure a system wide quality in data storage, management and accessibility. Information technology is by far the key component that binds together and empowers NEON and will be closely scrutinized by the community through the peer review process. Every workshop has included a strong emphasis on the critical importance of adequate metadata, or data quality and characteristics. Support for long-term archiving of data and metadata will be provided through NEON management and operations budgets.

Question submitted by Representative Nick Smith

CENTERS FOR LEARNING & EDUCATION IMPROVEMENT CENTERS FOR PLANT GENOME & GENE EXPRESSION

Q1. The National Science Foundation Authorization Act of 2002, P.L. 107–368, contains specific program authorizations for centers for research on learning and education improvement, and for plant genome and gene expression research centers. What are your plans to move forward on these initiatives?

A1. In response to Section 11 (Establishment of Centers for Research on Mathematics and Science Learning and Education Improvement) of Public Law 107–368, NSF will, with respect to the newly authorized Science of Learning Centers (SLC) program, combine new tools, new methods, and collaborations across disciplines to explore: (1) the process of learning; (2) the context in which learning is situated; and (3) the technologies that will improve learning, access to learning and research on learning. Comparable in significance and scope of activities to NSF's hallmark Science and Technology Centers and Engineering Research Centers, SLCs will build on standing research programs across the Foundation, integrating across the frontiers of multiple science and engineering disciplines. Thus, the science of learning emerges from the intersections of diverse disciplines across the biological, cognitive, computational, mathematical, physical and social sciences, engineering and education. Areas include psychological; social and pedagogical aspects of learning; biological bases of learning; feedback networks such as molecular recognition; machine

learning; learning technologies; and mathematical analyses and modeling of all of these.

The program will support large-scale, multidisciplinary and multi-institutional centers that serve as national resources to extend the frontiers of knowledge on learning and create the intellectual, organizational, and physical infrastructure needed for the long-term advancement of learning research. Built around a unifying research focus, each SLC will incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, international partners, all levels of education and other public and private entities.

The FY 2004 request for this program is $20.0 million, providing funds for three to four centers (at approximately $3.0 million to $5.0 million per year) and for 20 or more catalyst projects, which are smaller, partnership-building and proof-of-concept collaborative research activities that could eventually develop into centers. They are funded for up to two years at up to $250,000 total, with up to $50,000 additional for international collaborative activities. Following extensive input from within the Foundation and guidance from NSF management and the National Science Board, we are now ready to implement the program.

In Section 8 (Specific Program Authorizations) of the reauthorization bill, NSF is directed to support regional plant genome and gene expression research centers that conduct research and dissemination activities. Since its inception, the Plant Genome Research program has supported plant genome virtual centers. Virtual centers (centers without walls) consist of investigators from multiple institutions with diverse backgrounds and expertise. All virtual center awards are required to integrate research and education. Plant genomics research provides an ideal environment to expose young people to the biology of the 21st century. In addition, most of these center awards focus on gene expression studies.

Examples of Plant Genome Research Centers, which focus on gene expression studies, include:

- "A protein Interaction Database for Rice Protein Kinase" at University of Nebraska/University of Missouri/University of Florida/University of Arizona/University of California at Davis;
- "Functional Genomics of Hemicellulose Biosynthesis" at Michigan State University/University of California at Riverside; and
- "Comparative Genomics of Cotton" at Iowa State University/University of Georgia/University of Arizona.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Robert G. Card, Under Secretary for Energy, Science, and Environment, U.S. Department of Energy

Questions submitted by Representative Ralph M. Hall, Minority Ranking Member

HYDROGEN BUDGET

Q1. The Administration demonstrated a commitment to a hydrogen economy through increased funding for the FreedomFuels and FreedomCAR programs. How much of the increase is new money in the Department budget as a whole, as well as within the recipient programs EERE, Fossil, and Nuclear? How much is transferred from existing energy efficiency programs? How did nonhydrogen programs fare in the FY04 budget?

A1. Of the $1.7 billion committed to the FreedomCAR partnership and the President's Hydrogen Fuel Initiative over the next 5 years, $720 million is "new" money (i.e., above the otherwise assumed baseline). The total DOE FY 2004 budget request for the FreedomCAR and Hydrogen Fuel Initiatives totals *$272.8 million, including:*

- $165.5 million for EERE's Hydrogen, Fuel Cell, & Infrastructure Technology program
- $91.5 million for FreedomCAR & Vehicle Technologies program
- $11.5 million for Office of Fossil Energy
- $4 million for Office of Nuclear Energy
- $0.7 million for DOT's Research & Special Programs Administration

The FY 2004 Budget includes increases over EERE's FY 2003 budget request in the following amounts and program areas: $48.1 million for Hydrogen Technology, $20 million for Fuel Cell Technology, and $16.6 million for Vehicle Technologies activities that support the PreedomCAR partnership ($3.0 million for Vehicle Technologies on a net basis).

EERE funding from FY 2003 to FY 2004 is relatively flat. EERE's FY 2004 Budget Request for every non-hydrogen R&D program except Biomass and Industrial Technologies remains nearly level with its FY 2003 Congressional Appropriation. Funding for Biomass R&D was shifted in light of complementary funding in the 2002 Farm Bill, as well as termination of large-scale gasification activities that are largely within industry's capability. Reductions in Industrial Technologies R&D result from recognition that the industrial sector is the most energy efficient sector of our economy, and industries, particularly energy-intensive industries, have the economic incentive and are succeeding in their attempts to be more energy efficient. The Administration's R&D investment criteria helped guide our investment decisions.

Q2. While the Administration's unveiling of the FreedomFuels/FreedomCAR program is commendable, is it wise to fund this research at such a high level so early in the game, especially if it comes at the cost of reduced funding in almost all other R&D efforts?

A2. The FY 2003 budget request represents a balanced and prioritized R&D portfolio. This request focuses more efforts on longer-term and/or higher risk R&D with substantial potential benefits for the taxpayer investments.

Reducing our dependence on imported oil is one of our top priorities among Energy Efficiency and Renewable Energy programs. Over the last year, the Department worked with industry, academia, and other stakeholders to develop a hydrogen roadmap—a realistic, cost-effective plan to achieve the President's vision. The budget identifies specific technology goals and milestones which we will use to evaluate the technology development progress.

Question submitted by the House Committee on Science

Program Assessment Rating Tool

Q3. How does the FY 2004 budget request reflect the department's performance according to OMB's much touted investment criteria called the Program Assessment Rating Tool, or PART? Please refer to specific examples from the budget

that show both an increase and decrease in funding, and a reorganization due to performance in the PART system.

A3. This Administration is moving forward aggressively to integrate performance into the budget process. The Program Assessment Rating Tool (PART) contributed significantly to the FY 2004 budget formulation effort. The Department has worked closely with OMB to arrive at the ratings, which were factored into budget decisions.

We have provided additional funding to several programs who have scored well, such as the National Nuclear Security Administration's International Nuclear Materials Protection & Cooperation program, which received an Effective rating. We have also redirected some programs who did not do as well, such as the Fossil Energy Oil and Gas programs. However, a low score does not necessarily mean a reduction of funding. An example of this is the Environmental Management program where this Administration, using PART, identified a program that was not as productive or as cost-effective as it should be, and we have taken action to change this. In fact, the funding for this program was increased as part of our turnaround strategy. While reorganization options are being considered within the Department, none are directly related to PART results.

Questions submitted by Representative Ralph M. Hall, Minority Ranking Member

Q4. What programs will be transferred to the Office of Electric Transmission and Distribution? What are the problems this new office is expected to resolve in the Transmission and Distribution areas? Will distributed generation and transmission reliability R&D continue to be funded at their current levels? Are there other newly created offices with a substantial R&D component?

A4. The Office of Electric Transmission and Distribution initially will contain the following programs: High Temperature Superconductivity, Transmission Reliability, Distributed Integration, Electric Storage and Electricity Restructuring. In addition, the office will do electricity policy modeling and analysis, coordinate with the Power Marketing Authorities and oversee the regulation of electricity exports and the permitting of international electric transmission lines. Of course, other programs and functions may be added later.

The mission of the new office is to lead a national effort to modernize and expand America's electricity delivery system to ensure economic and national security. In the near term, modeling and analysis of the grid, introduction of new systems operational tools for industry, and facilitation with FERC and the States on advancing the electricity market will be the primary objectives of the new office. In the longer term, the office will continue to work with industry to develop technologies that promise public benefits and that the private sector would not undertake without Federal support, consistent with the Administration's R&D investment criteria.

As part of the formation of the new office, the Department is working with industry to develop a transmission and distribution vision and technology roadmap. These documents will help identify key technical challenges and the role of industry and government in addressing them. We anticipate that the documents may inform future budget decisions. In FY04 we request $3 million to initiate a transmission response initiative.

In forming the new office, DOE wanted to co-locate electricity R&D with policy and market analysis to improve synergies in the Department's response to the nation's critical needs for electricity planning. We are not aware of other offices implementing this strategy.

Q5. What programs or types of programs have been targeted in this year's massive cut in biomass and biorefinery R&D? What was the reasoning behind the large cuts in biomass R&D? What kind of interagency coordination is going on between DOE and the Department of Agriculture where other biomass and biorefinery programs are authorized to ensure the development of this potential energy resource?

A5. Funding allocations within the federal R&D portfolio reflect Administration priorities, program performance, program alignment with the Administration's R&D investment criteria, potential public benefits, and other factors, including efficiencies realized by combining all biomass research under one program and bringing to completion research on some technologies that ate ready to be commercialized. One example of a terminated biomass activity is industrial gasification. Industrial gasification activities under the Interior Appropriation will not be funded in FY

2004 because the R&D is at a stage where industry can pursue it without further federal support.

In addition, the 2002 Farm Bill makes mandatory funding available to USDA so that USDA and DOE can jointly pursue the technological challenges to making biorefineries commercially viable. In FY 2003, under a joint solicitation required by the Biomass R&D Act of 2000, USDA will award up to $16 million and DOE up to $5 million for cost-shared R&D work identified in the Act. USDA's focus is on environmental performance, economic viability, and feedstock production. DOE's focus is on faster and cheaper conversion of biomass to fuels and other bio-based products, and on syngas clean-up and conditioning. In addition, the two agencies have been collaborating and/or coordinating on numerous activities such as the sustainability analysis of corn stover harvesting and conversion to ethanol.

Finally, various earmarks reduced the coherence of the biomass and biorefinery program and significantly constrained the ability of our scientists and engineers to move these important technologies forward. Thus, when the tough choices were made about funding the most important research for our Nation's energy security, environmental, and economic goals, the focus was shifted to other areas where there could be greater R&D effectiveness.

Nevertheless, the Department recognizes the tremendous potential of a well-focused biomass R&D program to develop biorefinery technologies that can produce fuels, power, and high-value chemicals and other products and is working to move this R&D forward.

International Thermonuclear Experimental Reactor

Q6. The Secretary recently announced our re-commitment to ITER with a total of $500 million over eight years for the U.S., $12 million of which is requested for FY 2004. What activities will be undertaken in FY 2004 to restart our participation on the collaboration on ITER? Can you give us a rough timeline as to what the annual request would be over the proposed eight-year period?

A6. The requested $12 million will be used for preparatory work before the construction project begins and is, therefore, not part of the U.S. contribution to the construction project.

We will be orienting both science and technology activities toward support of the ITER preparations. The science activities include both specific operating time on the DIII–D and Alcator C–Mod facilities, to address physics questions of importance to ITER, as well as theory and computation supportive of ITER operation. The technology activities include direct participation in the ongoing work of the ITER International Team located at Garching, Germany and Naka, Japan which is focused on improving and completing the design as part of the interaction with regulatory authorities. It also includes some tasks at home in support of this work.

Assuming a construction start in FY 2006 and no delays associated with either the formal agreements, establishment of the necessary international ITER legal entity, or obtaining the license to begin the construction, the first construction funds would be sought for FY 2006. The annual funding profile will be subject to the outcome of the negotiation, as the allocation of component responsibilities to each party would affect the schedule for those components and associated costs. In addition, our contribution will need to incorporate contingency, in accordance with standard DOE practices, as well as escalation. And some components will require R&D before industrial contracts could be placed. Therefore, it is premature for me to predict the annual funding request for the U.S. contribution at this time.

Climate Research Activities

Q7. What provision does the FY 2004 budget request make for managing and archiving the data collected from the climate research activities supported by your department?

A7. Data management activities are incorporated in the Climate Change Research subprogram budget. Data include the Atmospheric Radiation Measurement observations, seeking to understand the role of clouds in climate change, and the carbon cycle observation from the AmeriFlux network that seeks to understand and quantify the net exchange of carbon between the atmosphere and major terrestrial ecosystems in North America. All data are quality assured, archived, and made available to the public.

Question submitted by Representative George R. Nethercutt

Q8. The DOE has set a goal of 2015 for the completion of the R&D phase of the FreedomCAR hydrogen car initiative. Please explain the groundwork you are laying now to allow a smooth federal exit of hydrogen funding and how industry is likely to pick up where federal R&D leaves off?

A8. The Department will fund national laboratories and universities and co-sponsor industry research and development to overcome the high risk, "critical path" barriers. These barriers include hydrogen production efficiency and cost, hydrogen storage, fuel cell cost, hydrogen delivery cost, and lack of approved codes and standards. Following validation (through system demonstration and/or analysis) of research targets established in each area, the federal role in research would be ramped down.

If industry makes a positive commercialization decision by 2015, it will be industry's responsibility to make investments in automotive manufacturing, sales and service, and hydrogen production and delivery infrastructure. Government policies or incentives could be evaluated to accelerate vehicle and refueling infrastructure.